

**Actuarial Review of the
Federal Housing Administration
Mutual Mortgage Insurance Fund
Forward Loans
for Fiscal Year 2014**

November 17, 2014

Prepared for



U.S. Department of Housing and Urban Development

By



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November 17, 2014

The Honorable Biniam T. Gebre
Assistant Secretary for Housing – Federal Housing Commissioner
U.S. Department of Housing and Urban Development
451 Seventh Street, SW, Room 9100
Washington, DC 20410

Dear Mr. Gebre:

IFE Group has completed and, along with this letter, is submitting the fiscal year 2014 Actuarial Review of the Mutual Mortgage Insurance Fund Forward Loans (the Fund).

We estimate that the Fund's economic value as of the end of fiscal year 2014 was *positive* \$5.93 billion and the unamortized insurance in force was \$1,154.82 billion. We project that at the end of fiscal year 2021 the Fund's economic value will be \$80.54 billion and the unamortized insurance in force will be \$1,420.35 billion. Our sensitivity analysis indicates that there is approximately an 84 percent probability that the FY 2014 economic value would be positive.

The financial estimates presented in this Review require projections of events more than 30 years into the future. These projections are dependent upon the validity and robustness of the underlying model and assumptions about the future economic environment and loan characteristics. These assumptions include economic forecasted by Moody's Analytics and the assumptions concerning compositions of future endorsement portfolios projected by FHA. To the extent that actual events deviate from these or other assumptions, the actual results may differ, perhaps significantly, from our current projections. The models used for this Review are, by nature, large and complex. We applied an extensive validation process to assure that the results reported in this Review are accurate and reliable. The full actuarial report explains these projections and the sources for the changes since last year's actuarial review.

Very truly yours,

Tyler T. Yang, Ph.D.
Chairman and CEO
Integrated Financial Engineering, Inc.

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I have reviewed the “Actuarial Review of the Federal Housing Administration Mutual Mortgage Insurance Fund, Forward Loans, for Fiscal Year 2014 ”. The purpose of my review was to determine the soundness of the methodology used, the appropriateness of the underlying assumptions applied, and the reasonableness of the resulting estimates derived in the Review.

The Review was based upon data and information prepared by the Federal Housing Administration (FHA). I have relied upon the FHA for the accuracy and completeness of this data. In addition, I also relied upon the reasonableness of the assumptions used in the economic projections prepared by Moody’s Analytics, from which the base case used in the Review was derived.

It is my opinion that on an overall basis the methodology and underlying assumptions used in the Review are reasonable and appropriate in the circumstances. In my opinion the estimates in the Review lie within a reasonable range of probable values as of this time although the actual experience in the future will not unfold as projected.



Phelim Boyle, Ph.D., FIA, FCIA
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November 17, 2014

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Executive Summary

The 1990 Cranston-Gonzalez National Affordable Housing Act (NAHA) requires an independent actuarial analysis of the economic net worth of the Federal Housing Administration's (FHA's) Mutual Mortgage Insurance Fund. The Housing and Economic Recovery Act of 2008 (HERA) moved the requirement for an independent actuarial review into 12 USC 1708(a)(4). This report presents the results of our analysis for fiscal year (FY) 2014.

HERA also moved several additional programs into the Mutual Mortgage Insurance Fund. One of them, Home Equity Conversion Mortgages (HECMs, which are reverse mortgages) is analyzed separately and is excluded from this Review. *In the remainder of this Review, the term “the Fund” refers to the MMI Fund excluding HECMs.*

The primary purpose of this Actuarial Review is to estimate:

- the *economic value* of the Fund, defined as the existing capital resources, or total assets less total liabilities of the Fund, plus the net present value (NPV) of the current books of business, **excluding HECMs**, and
- the *total insurance-in-force (IIF)* of the Fund, **excluding HECMs**.

This year, we followed last year's approach and used a stochastic method to estimate the net present value of future cash flows. In 2011 and previous Reviews, the net present value of the cash flows was computed along a single, deterministic path of house prices and interest rates. Starting from the 2012 Review, instead of a single path, we generated 100 equally likely paths to conduct a Monte Carlo simulation, and computed the net present value of the cash flows for each of the paths. Then we averaged these 100 numbers to obtain our estimate of the expected net present value of the future cash flows under our simulation procedure. This is our baseline estimate.

Based on our stochastic simulation analysis, we estimate that the economic value of the Fund as of the end of FY 2014 is *positive* \$5.93 billion. This represents a \$13.80 billion improvement from the *negative* \$7.87 billion economic value estimated in the FY 2013 Review. Because the HECM portfolio is excluded from this analysis, we do not report the capital ratio of the Fund.

We project that there is approximately an 84 percent probability that the FY 2014 economic value is positive. We also estimate that under the worst path among the simulated stochastic scenarios, the economic value could stay negative through FY 2021. The FY 2014 economic value under the worst path in the Monte Carlo simulation is *negative* \$31.43 billion and under a modified Moody's protracted slump scenario it is *negative* \$40.01 billion.

A. Status of the Fund

Exhibit ES-1 reports the estimates of the Fund's current and future economic value and insurance-in-force (IIF) using 100 simulated paths and taking the average of the resulting 100 economic values. Both the economic value and the IIF of the Fund are expected to increase each year over the next seven years.

Exhibit ES-1: Projected Fund Performance for FYs 2014 through 2021 (\$Millions)

Fiscal Year	Economic Value of the Fund ^a	Unamortized Insurance-in-Force ^b	Amortized Insurance-in-Force ^b	Economic Value of Each New Book of Business	Volume of New Endorsements ^c	Investment Earnings on Fund Balances
2014	5,932	1,154,818	1,059,925	11,788	134,000	
2015	16,161	1,158,756	1,049,949	10,213	124,505	17
2016	24,201	1,184,196	1,060,024	7,851	113,488	189
2017	33,022	1,220,041	1,079,960	8,275	119,065	547
2018	43,780	1,264,146	1,107,688	9,712	136,883	1,046
2019	55,330	1,311,234	1,137,046	9,856	141,338	1,695
2020	67,349	1,362,153	1,168,977	9,747	147,547	2,272
2021	80,541	1,420,350	1,207,055	10,364	159,462	2,828

^a All values are as of the end of each fiscal year. The economic value for FYs 2014 through 2021 is equal to the economic value of the Fund at the end of the previous year, plus the current year's interest earned on the previous Fund balance, plus the economic value of the new book of business.

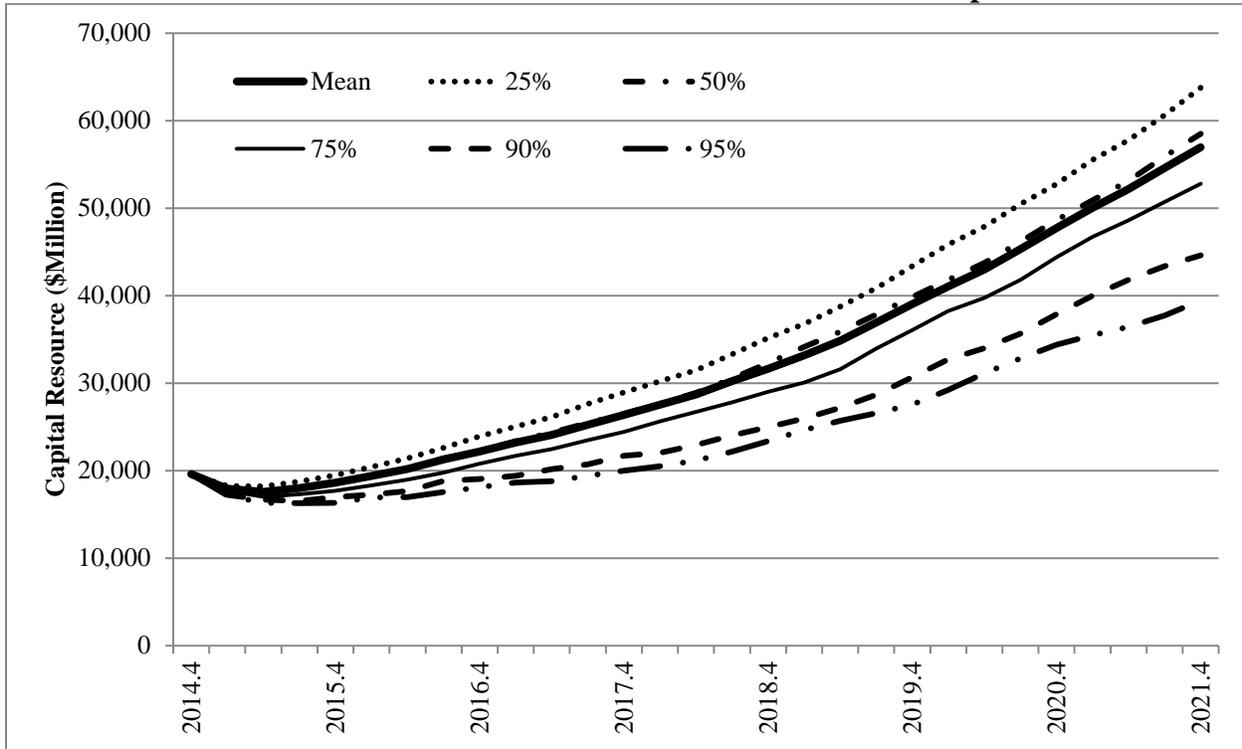
^b Estimated based on the data extract as of June 30, 2014, our model of new endorsement volumes, and projected loan performance.

^c Based on our endorsement volume forecast model described in Appendix F.

In defining the statutory capital ratio, NAHA stipulates the use of unamortized insurance-in-force as the denominator. However, "unamortized insurance-in-force" is defined in the legislation as "the remaining obligation on outstanding mortgages" – which is generally understood to describe amortized IIF. To allow flexibility to calculate the capital ratio under either definition, both the unamortized and amortized IIFs are reported in this Review.

The capital resources of the Fund at the end of FY 2014 are \$19.62 billion. We simulated the capital resources over the next seven years along the 100 possible future economic scenarios of the stochastic simulation. From the 95th percentile path shown in Exhibit ES-2, we infer that there is approximately only a 5 percent chance that the capital resources may fall to around \$16 billion during the next seven years.

Exhibit ES-2: Mean and Selected Monte Carlo Percentiles for MMI Capital Resources



B. Sources of Change in the Status of the Fund

Change in Economic Value from FY 2013 to FY 2014

We estimate that the economic value of the Fund was *positive* \$5.93 billion as of the end of FY 2014, which represents an increase of \$13.80 billion compared to the FY 2013 economic value of *negative* \$7.87 billion. Meanwhile, there has been an \$18 billion decrease in the estimated unamortized IIF from the FY 2013 value of \$1,173 billion, to \$1,155 billion.

Current Estimate of FY 2014 Economic Value Compared with the Estimate Presented in the FY 2013 Actuarial Review

Our current estimate of the FY 2014 economic value is \$1.91 billion lower than the economic value projected for FY 2014 in the FY 2013 Actuarial Review. Our current estimate of the FY 2020 economic value is \$67.35 billion, which is \$17.52 billion lower than estimated in the FY 2013 Actuarial Review. The FY 2014 differences are attributed to the following changes,

with the magnitude of the change in the estimated FY 2014 economic value shown in parentheses for each source:

- Including the Fund transfer from the HECM Financing Account (+\$0.77 billion)
- Updating the estimated origination volume of the FY 2013 and FY 2014 books of business (-\$4.69 billion)
- Updating the discounting factors published by OMB (+\$0.10 billion)
- Updating actual performance in FY 2013-FY 2014 (+\$1.27 billion)
- Updating the econometric models (-\$2.84 billion)
- Updating the economic scenario forecast (+\$1.70 billion)
- Updating the loss mitigation cost share (-0.46 billion)
- Adjusting delayed claims (-0.01 billion)
- Adjusting the June & September Note Sale transactions (+0.27 billion)
- Adjusting TPS share projection (+\$1.21 billion)
- Adjusting future Note Sale (+\$0.76 billion)

In summary, the estimated economic value of the Fund increased during FY 2014 but is \$1.91 billion lower than that estimated last year. Without the transfer from HECM, the Fund would have been \$2.68 billion lower than what was estimated in last year's Review.

Additional Comments

The estimates presented in this Review reflect projections of events more than 30 years into the future. These projections are dependent upon a number of assumptions, including economic trend forecasts by Moody's Analytics and the assumption that FHA does not change its policies regarding refunds, premiums, distributive shares, underwriting or servicing rules, and administrative expenses. To the extent that these or other assumptions are subject to change, the actual results may vary, perhaps significantly, from our current projections.

Estimation of the variables in the models used for predicting prepayments and claims depends on large amounts of loan-level data, requiring extensive data processing. To complete the Review within the timeframe required by HUD, we used the actual historical loan-level data as of March 31, 2014 provided by HUD. We supplemented that with various updates up to October 2014. Although we have not audited the data for accuracy, we have reviewed the data provided by HUD for integrity and consistency and believe it to be reasonable. However, the information contained in this report may not correspond exactly with other published analyses that rely on HUD data compiled at different times or obtained from other systems.

The economic value estimate reported in this Actuarial Review is based on many components, including behavioral models derived from historical data, forecasts for major macroeconomic

drivers and stochastic paths generated by Monte Carlo simulation algorithms. Our modeling approach is based on our experience and research in this field and on the relevant literature. However, it is not the only way to build such models. We recognize that other capable modelers may use different assumptions and models and thus obtain different estimates.

C. Impact of Economic Forecasts

The economic value of the Fund and its pattern of capital accumulation to FY 2021 depend on many factors. One of the most important factors is the prevailing economic conditions over the next 37 years, and most critically during the first 10 years of that time period. We captured the most significant factors in the U.S. economy affecting the performance of the loans insured by the Fund through the use of the following variables in our models:

- 30-year fixed-rate home mortgage commitment rates
- Ten-year Treasury rates
- One-year Treasury rates
- Growth rate of local house prices
- Local unemployment rates

The projected performance of FHA's books of business, measured by their economic value, is affected by changes in these economic variables. The baseline results of this report are derived from Monte Carlo simulations centered on Moody's Analytics quarterly forecasts for interest rates and MSA-level house price appreciation rates and unemployment rates, which Moody's Analytics forecasted along with other macroeconomic and regional variables, as of July 2014.

We also estimated the economic value of the Fund under seven additional economic scenarios. The first five of these come from a ranking of the FY2014 economic values produced by our 100 simulation paths from the highest FY2014 economic value to the lowest. The sixth scenario corresponds to Moody's Protracted Slump Scenario. The last one is the Moody's baseline forecast as a deterministic scenario.

- 10th Best Path in Simulation
- 25th Best Path
- 25th Worst Path
- 10th Worst Path
- Worst Path
- Moody's Protracted Slump Scenario
- Moody's Baseline Forecast as a Deterministic Scenario

These seven scenarios do not represent the full range of possible experience, but they represent different levels of variation under different economic conditions, and hence provide insights into the projected performance of the Fund under a range of economic environments. Using the results shown in Exhibit ES-3, we infer that there is an 80 percent chance that the FY 2014 economic value is in the range of *negative* \$3.04 billion and *positive* \$14.58 billion. From the worst path in the simulation, we infer that there is a 99.5 percent probability that the FY 2014 economic value would be better than *negative* \$31.43 billion. Under a modified Moody's protracted slump scenario the FY 2014 economic value would be *negative* \$40.01 billion. Also from our simulated scenarios, we infer that there was approximately an 84 percent chance the FY 2014 economic value would be positive.

Exhibit ES-3: Projected Fund's Economic Value Under Alternative Economic Scenarios
(\$ Millions)

Fiscal Year	Baseline Monte Carlo	10th Best Path	25th Best Path	25th Worst Path	10th Worst Path	Worst Path	Moody's Protracted Slump	Moody's Baseline
2014	5,932	14,581	10,873	2,277	-3,040	-31,430	-40,010	10,075
2021	80,541	66,427	81,461	85,155	96,905	-411	11,329	89,893

Impact of Downpayment Assistance Program

The passage of HERA prohibits FHA's endorsement of seller-financed downpayment assistance loans on or after October 1, 2008. These loans experienced claim rates that were considerably higher than otherwise comparable non-assisted loans. The share of loans with downpayment assistance from non-profit organizations quickly diminished after the passage of HERA. The significance of eliminating these types of loans is highlighted by our estimate that if these non-profit-assisted loans had always been excluded, the economic value of the Fund would have improved by \$16.00 billion, resulting in an economic value of \$21.94 billion in FY 2014.

Section I: Introduction

The 1990 Cranston-Gonzalez National Affordable Housing Act (NAHA) mandated that the Federal Housing Administration's (FHA's) Mutual Mortgage Insurance (MMI) Fund maintain a capital ratio of 2 percent from October 1, 2000 forward. The capital ratio is defined by NAHA as the ratio of the Fund's economic value to its unamortized insurance-in-force (IIF). NAHA also established the requirement for the MMI Fund to undergo an annual independent actuarial review. The Housing and Economic Recovery Act of 2008 (HERA) moved the requirement for an independent actuarial review into 12 USC 1708(a)(4).

IFE Group was engaged by the Department of Housing and Urban Development (HUD) to conduct the independent actuarial review to estimate the economic value and IIF of the forward mortgages in the MMI Fund for FY 2014. One of the programs that was moved into the MMI Fund, Home Equity Conversion Mortgages (HECMs), is analyzed in a separate report and is excluded from this document. HUD will combine the results from the two separate reports to compute the consolidated economic value and capital ratio of the entire MMI Fund. The combined economic value and capital ratio of the entire MMI Fund are the measures specified by Congress to assess whether the MMI Fund meets the capital standards set forth in NAHA. We will refer to the forward mortgage portfolio excluding HECMs as "the Fund" in this report.

The analysis in this Review relies on information provided by HUD, such as the historical performance of the existing loans in the Fund and the projected composition of future mortgage originations. It also relies on future economic conditions based on forecasts published by Moody's Analytics. IFE Group has created a distribution of simulation paths around Moody's baseline forecast to estimate the economic value of the Fund.

A. Implementation of NAHA

Following release of the FY 1989 Actuarial Review and the ensuing debate, Congress mandated various changes to the MMI Fund. The required revisions focused on five major issues: (1) development of an actuarial standard of financial soundness, (2) modification of the minimum borrower downpayment requirement, (3) changes in insurance premiums, (4) limitations on distributive shares and (5) modification of underwriting standards and data requirements.

The changes called for in the Act were specifically designed to remedy the financial difficulties encountered by the MMI Fund during the 1980s. Each change was intended either to reduce risks inherent in new books of business or to adjust premiums to more adequately compensate for the risks.

The NAHA legislation required that the MMI Fund be operated on an actuarially sound basis. It provided specific capital standards and timeframes over which those standards should initially be met. It also defined the critical actuarial measure as the ratio of the MMI Fund's capital, or economic value, to its unamortized IIF, defined by the legislation as the remaining obligation on outstanding mortgages. This ratio thus established the capital standard for the MMI Fund, which subsequently included HECMs.

To further strengthen the capital position of the MMI Fund, the NAHA legislation linked FHA's ability to pay distributive shares to the actuarial soundness of the entire MMI Fund (as defined in the legislation), rather than solely considering the performance of the loans endorsed during a particular year, as had been done in years prior to 1990. This amendment allowed distributive share payments only if the MMI Fund achieved the capital standard established by the legislation, and then at the discretion of the Secretary of HUD. No distributive shares have been paid since the passage of NAHA. In prior Reviews, we have assumed continuation of the current HUD policy that no distributive shares will be paid, and we continue to make that assumption in the 2014 Review.

B. FHA Policy Developments and Underwriting Changes

Since the mid-1990's, FHA has implemented a number of policy changes that affected the financial strength of the MMI Fund. Major changes have included revised underwriting guidelines, changes to homeownership counseling requirements, implementation of automated underwriting systems, changes to upfront and annual mortgage insurance premium schedules, changes in loan limits, elimination of seller-financed downpayment assistance, and foreclosure avoidance and loss mitigation programs. Each of these developments is summarized below.

1. Revised Underwriting Guidelines and Other Policy Issues

In 1995, FHA introduced several changes in their underwriting guidelines to eliminate unnecessary barriers to homeownership, provide flexibility to underwrite creditworthy non-traditional and underserved borrowers, and clarify certain underwriting requirements so that they would not be applied in a discriminatory manner. While these modifications enabled many additional households to become homeowners, the relaxation of the underwriting rules also contributed to an increase in FHA claim rates for loans originated after 1995.

Changes were made in 1998 to the underwriting guidelines for adjustable rate mortgages (ARMs) to address the high losses on ARMs that FHA was experiencing. Based on FHA's study of ARM claim rates, it was deemed necessary to change credit policies to maintain the MMI Fund's actuarial soundness. As a result of these changes, ARM borrowers must qualify using a

mortgage payment level based on the maximum possible second-year interest rate. Also, any form of temporary interest rate buy-down for ARMs could no longer be used to create qualifying payment ratios.

In 2008, HERA increased the minimum borrower cash equity requirement to 3.5 percent for purchase loans.¹ FHA also established a minimum FICO score of 500 for loans with 90 percent or higher loan-to-value ratios. This rule was further tightened in 2010.² Starting October 4, 2010, borrowers with credit scores below 500 were no longer eligible for FHA insurance, and the maximum loan-to-value ratio for borrowers with credit scores between 500 and 579 was limited to 90 percent. In 2011, FHA removed eligibility for loans with investor property.³ In 2012, FHA modified documentation requirements for self-employed borrowers. Starting from April 1, 2012, profit-loss and balance sheets of self-employed borrowers have been required in most cases.⁴ Also for the purpose of identity-of-interest transactions, the family member definition was expanded to include the extended family, including brothers, sisters, uncles and aunts.

For manually underwritten loans assigned on or after April 21, 2014, HUD clarifies a series of maximum qualifying ratios for different lowest minimum decision credit scores and acceptable compensating factors.⁵ It also revises the compensating factors that must be cited to exceed the FHA's standard qualifying ratios for manually underwritten loans.

2. Changes to the Homeownership Counseling Discount

Another focus of the 1998 revisions was homeownership counseling. Previously, first-time homebuyers receiving counseling were eligible for a reduced upfront FHA insurance premium. While FHA permitted HUD-approved homeownership counseling programs, unacceptable practices were observed, such as borrowers simply being asked to complete homeownership workbooks without any additional interaction with the counseling program. The new rule required that the type of homeownership counseling obtained by first-time homebuyers must be examined by FHA's quality assurance staff as part of its regular reviews of lenders. FHA required that counseling be delivered in a classroom setting, face-to-face or via electronic media, and involve 15 to 20 hours of instruction. When the upfront premium was reduced in 2001 for all FHA borrowers, there was no longer a separate discount for borrowers who went through homeownership counseling programs. The discount is only required by law if FHA charges the maximum upfront premium. A pilot program, Homeowners Armed with Knowledge (HAWK),

¹ Mortgagee Letter 2008-23, September 5, 2008: Revised Downpayment and Maximum Mortgage Requirements.

² Mortgagee Letter 2010-29, September 3, 2010: Minimum Credit Scores and Loan-to-Value Ratios.

³ HUD 4155.1, Section B. Property Ownership Requirements and Restrictions. 4155.1 4.B.1.a: Occupancy Restrictions

⁴ Mortgagee Letter 2012-03, February 28, 2012: Miscellaneous Underwriting Issues.

⁵ Mortgagee Letter 2014-02, January 21, 2014: Manual Underwriting.

however, will provide FHA insurance pricing incentives to first-time homebuyers that participate in housing counseling and education. This program announcement is published in May 15th, 2014⁶.

3. Automated Underwriting Systems

In 1998, FHA approved Freddie Mac's Loan Prospector for underwriting FHA-insured mortgages. FHA also made a substantial number of revisions to its credit policies and reduced documentation requirements for loans assessed by Loan Prospector. This was the first time that FHA incorporated an automated underwriting system (AUS) in its insurance endorsement process. Fannie Mae's Desktop Underwriter and PMI Mortgage Services' pmiAURA were approved to underwrite FHA mortgages in 1999, followed soon thereafter by Countrywide Funding Corporation's CLUES and JP Morgan-Chase's Zippy. Beginning in May 2004, all approved AUSs applied FHA's Technology-Open-To-Approved-Lenders (TOTAL) mortgage scorecard to evaluate loan applications for possible automated approval for FHA insurance. Initially, more than two-thirds of loans submitted generally received automated approval, eliminating the need for manual underwriting reviews. Since May 2004, HUD required lenders to submit borrower credit scores. Starting from July 2008, all loans must be submitted through FHA's TOTAL scorecard. A new guidance issued in February 2011 prohibits the use of TOTAL scorecard on streamline refinance transactions⁷.

4. Changes in Mortgage Insurance Premiums

In response to the FY 2009 estimate that the capital ratio had fallen below the statutory two percent level, FHA made several changes to the mortgage insurance premium structure. Effective for the loans endorsed after April 5, 2010, FHA increased the upfront mortgage insurance premium from 1.75 percent to 2.25 percent.⁸

On Aug 12, 2010, Public Law 111-229 provided the Secretary of HUD with additional flexibility regarding the mortgage insurance premiums for FHA loans. Specifically, the law increased the upper limit of annual mortgage insurance premiums. Starting October 4, 2010, the upfront premium was reduced to 1.00 percent for all mortgage types, while the annual premium for loans with 30-year terms was increased to 85 basis points for LTV ratios less than or equal to 95 percent, and to 90 basis points for LTV ratios exceeding 95 percent. For loans with 15-year terms, an annual premium of 25 basis points was charged on loans with LTVs higher than 90 percent.⁹ The annual insurance premium was further increased by another 25 basis points for all

⁶ http://portal.hud.gov/hudportal/documents/huddoc?id=OHC_HAWKFR051314.pdf

⁷ Mortgagee Letter 2011-11, February 14, 2011: FHA Refinance Transactions.

⁸ Mortgagee Letter 2010-02, January 21, 2010: Increase in Upfront Premiums for FHA Mortgage Insurance.

⁹ Mortgagee Letter 2010-28, September 1, 2010: Changes to FHA Mortgage Insurance Premiums.

loans starting April 18, 2011.¹⁰ On December 23, 2011, the President signed into law the Temporary Payroll Tax Cut Continuation Act of 2011 (Public Law 112-78), which included a provision that required FHA to increase the annual MIP it collects by an additional 10 basis points. This change was effective for case numbers assigned on or after April 9, 2012.¹¹ For loans exceeding \$625,500, an extra 25 bps annual MIP was added starting June 11, 2012. The up-front premium was increased from 1 percent to 1.75 percent starting April 9, 2012. Certain exceptions were made for streamline refinance loans if the original FHA loan was endorsed on or before May 31, 2009 and starting with loan applications taken on June 11, 2012.

Under Public Law 111-229 (1)(b), FHA adjusted its annual MIP rates effective from April 1, 2013.¹² The annual premium for loans with 30-year terms and base loan amount below \$625,500 was increased to 130 bps for LTV ratios up to 95 percent, and to 135 bps for LTV ratios greater than 95 percent. The annual premium for 30-year loans with base loan amount above \$625,500 was increased to 150 bps for LTV ratios up to 95 percent, and to 155 bps for LTV ratios greater than 95 percent. For loans with 15-year terms and base loan amount below \$625,500, the annual premium was increased to 45 bps for LTV ratios up to 90 percent, and to 70 bps for LTV ratios greater than 90 percent; for 15-year loans with base loan amount above \$625,500, the annual premium was increased to 70 bps for LTV ratios up to 90 percent, and to 95 bps for LTV ratios greater than 90 percent. This increase was effective for all forward mortgages except single family forward streamline refinance transactions that refinance existing FHA loans that were endorsed on or before May 31, 2009. Effective on June 3, 2013, FHA eliminated the cancellation of annual MIP for loans with an LTV less than or equal to 78 percent and with terms up to 15 years. The annual MIP becomes 45 bps for these loans if their case numbers is assigned on or after June 3, 2013. In addition, the new duration of annual MIP for loans with an LTV up to 90 percent is 11 years, and it is for the life of the loan for LTV greater than 90 percent.

5. FHA Single-Family Loan Limits

In early March 2008, FHA announced a temporary loan limit increase as a result of the enactment of the Economic Stimulus Act of 2008 (ESA). The ESA provided that the mortgage limit for any given area shall be set at 125 percent of the median house price in that area, except that the FHA mortgage limit in any given area can neither exceed 175 percent of the 2008 Government Sponsored Enterprise (GSE)¹³ conforming loan limit of \$417,000, nor be lower than

¹⁰ Mortgagee Letter 2011-10, February 14, 2011: Annual Mortgage Insurance Premium Changes and Guidance on Case Numbers.

¹¹ Mortgage Letter 2012-04, March 6, 2012: Single Family Mortgage Insurance: Annual and Up-Front Mortgage Insurance Premium-Changes.

¹² Mortgagee Letter 2013-04, January 31, 2013: Revision of Federal Housing Administration (FHA) policies concerning cancellation of the annual Mortgage Insurance Premium (MIP) and increase to the annual MIP.

¹³ The GSEs are Fannie Mae, Freddie Mac, and the Federal Home Loan Banks.

65 percent of the same 2008 GSE conforming loan limit for a single-family, one-unit residence. FHA's single-family national loan limit ceiling for 2008 was revised to \$729,750. These loan limit increases were effective for mortgages endorsed for FHA insurance on or after March 6, 2008.¹⁴

Under HERA, the Federal Housing Finance Agency (FHFA) was established and directed to set GSE conforming loan limits each year for the nation as a whole, as well as for high-cost areas. HERA stipulated that the national loan limit for the GSEs during 2009 should remain at \$417,000. Effective January 1, 2009, and per HERA the FHA mortgage limit for any given area was set at 115 percent of the area median house price, with a ceiling of 150 percent of the GSE conforming loan limit, or \$625,500.¹⁵

In February 2009, the FHA single-family loan limits changed as a result of the American Recovery and Reinvestment Act of 2009 (ARRA, February 17, 2009). Those limits were effective for loans with credit approved in calendar year 2009.¹⁶ Under ARRA, the revised FHA loan limits for 2009 were set at the higher of the loan limits established for 2008 under ESA and those established for 2009 under HERA.

Under the authority of the Continuing Appropriations Act 2011, Public Law 111-242, the loan limits authorized by ARRA were extended to the end of FY 2011.¹⁷ Since both the ESA and HERA set the FHA national loan limit floor at 65 percent, the FHA loan limit floor also remained at the FY 2009 level, \$271,050. For the FHA national loan limit ceiling, the limit based on ESA (175 percent) was higher than that based on HERA (150 percent), and the national loan limit ceiling was set at \$729,750, which was again the same as in the previous year. Between October 1st, 2011, and November 18th, 2011, the national loan limit was reduced to \$625,500, which was the same as the GSE's national limit.¹⁸ The national loan limit for loans endorsed after November 18th, 2011 reverted to \$729,750¹⁹, which is higher than Fannie Mae's and Freddie Mac's conforming loan limit.²⁰

¹⁴ Mortgagee Letter 2008-06, March 6, 2008, Temporary Loan Limit Increase for FHA.

¹⁵ Mortgagee Letter 2008-36, November 7, 2008, 2009 FHA Maximum Mortgage Limits.

¹⁶ Mortgagee Letter 2009-07, February 24, 2009 Loan Limit Increases for FHA.

¹⁷ Mortgagee Letter 2010-40, December 1, 2010: 2011 FHA Maximum Loan Limits.

¹⁸ Mortgagee Letter 2011-29, August 19, 2011: Federal Housing Administration's (FHA) Maximum Loan Limits Effective October 1, 2011 through December 31, 2011.

¹⁹ This loan limit authority expired at the end of December 2013, and the national loan limit ceiling dropped from \$729,750 to \$625,500.

²⁰ Mortgagee Letter 2011-39, December 2, 2011: Federal Housing Administration Maximum Loan Limits Effective October 1, 2011 through December 31, 2012

6. Concentration of Loans with Downpayment Assistance

Non-profit-organization-assisted mortgages represented over twenty percent of the entire FY 2005, FY 2006, and FY 2007 books of business, and the percentage still exceeded fifteen percent in FY 2008. The prevailing FHA guidelines allowed such borrowers to use outright gifts of cash as downpayment assistance.²¹ A 2005 report by the Government Accountability Office (GAO) documented that many downpayment gifts provided by non-profit organizations were contributed by the home sellers involved in the specific transactions, and possibly through financing based on inflated house prices.²² The Passage of HERA on July 30, 2008 officially terminated the eligibility of loans with seller-funded downpayment assistance for FHA endorsements. Subsequently, the origination volume of such loans diminished rapidly and new endorsements with non-profit gifts have been virtually non-existent since the second quarter of FY 2009. The elimination of seller-financed downpayment assistance has had and will continue to have a significant effect in reducing losses on future FHA books. In April 2014, HUD provided a guidance to clarify whether government assisting nonprofit organizations' secondary financing program require HUD approval on the Nonprofit Organization Roster.²³

7. Foreclosure Avoidance and Loss Mitigation Program

One of the consequences of the severe housing recession has been the incidence of high foreclosure rates. FHA took actions to help families avoid foreclosure through loan modifications and partial claim initiatives, as well as default counseling provided by HUD-approved counseling agencies.

Since its introduction as a national program in 1994,²⁴ the pre-foreclosure sale (PFS) program has allowed mortgagors in default to sell their homes and use the sales proceeds in satisfaction of their mortgage debt even when the proceeds are less than the amount owed.²⁵ This approach has the benefit of reducing the total credit costs to FHA.

²¹ Eligible gift sources included: relatives, employers or labor unions, tax-exempt charitable organizations, governmental agencies, public entities that have programs to provide homeownership assistance to low- and moderate-income families or first-time homebuyers, or close friends with a clearly defined and documented interest in the borrower.

²² "Mortgage Finance Additional Action Needed to Manage Risks of FHA-Insured Loans with Downpayment Assistance," Government Accountability Office, November 2005.

²³ Mortgagee Letter 2014-08, April 29, 2014, Guidance on Nonprofits Assisting Government Entities in Providing Secondary Financing in Conjunction with FHA-Insured Mortgages.

²⁴ The regulations for the PFS Program are codified in 24 CFR 203.370.

²⁵ Mortgagee Letter 2008-43, December 24, 2008, Utilizing the PFS Loss Mitigation Option.

In 1996, as FHA terminated the loan assignment program, it also issued a series of initiatives to encourage servicers to apply various loss mitigation tools to avoid foreclosure.²⁶ This approach proved to be an effective way of keeping financially stressed borrowers in their homes and reducing credit losses. The implementation of loss mitigation tools ramped up quickly and became a significant part of FHA's risk management practices by FY 2002.

On May 20, 2009, President Obama signed into law the Helping Families Save Their Homes Act of 2009. The law permitted FHA lenders to offer families more substantial loan modifications and provided FHA with additional loss mitigation authority to assist FHA borrowers under the umbrella of the Home Affordable Modification Program (HAMP). Mortgagee letter 2009-23, effective August 15, 2009, announced an FHA Loss Mitigation option, or FHA-Home Affordable Modification Program (FHA-HAMP). FHA-HAMP provided opportunities to reduce mortgage payments of delinquent borrowers to sustainable levels. This program was designed to help FHA borrowers already in default or at "imminent" risk of default with opportunities to reduce payments by loan modification with principal deferment.

On March 26, 2010, HUD and the Department of the Treasury announced enhancements to the existing Making Home Affordable Program (MHA) and FHA refinance program that attempted to give a greater number of responsible borrowers an opportunity to remain in their homes.²⁷ These enhancements were designed to maintain homeownership by providing borrowers who owe more on their mortgage than the value of their home, opportunities to refinance into an affordable FHA loan. This opportunity allows borrowers who are current on their conventional mortgage to qualify for an FHA refinance loan, provided that the lender or investor writes down the unpaid principal balance of the original first-lien mortgage by at least 10 percent and borrower payment ratios meet program requirements.

On August 15, 2011, FHA issued servicing guidelines requiring trial payment plans for loan modification and partial claim actions.²⁸ Loans with certain high-risk characteristics are required to complete a minimum of a three-month trial period before a permanent standard modification and/or partial claim can be granted.

²⁶ Mortgagee Letter 96-25, May 8, 1996, Existing Alternatives to Foreclosure – Loss Mitigation; Mortgagee Letter 96-23, June 28, 1996, Loss Mitigation – Mortgage Modification; Mortgagee Letter 96-61, November 12, 1996, FHA Loss Mitigation Procedures – Special Instruction.

²⁷ Mortgagee Letter 2010-23, August 6, 2010, FHA Refinance of Borrowers in Negative Equity Positions.

²⁸ Mortgagee Letter 2011-28, August 15, 2011, Trial Payment Plan for Loan Modifications and Partial Claims under Federal Housing Administration's Loss Mitigation Program.

In 2013, FHA also extended its PFS eligibility for delinquent loans. Compared to the previous guideline in ML 2008-43,²⁹ the new PFS guideline in ML 2013-23³⁰ had less restrictive eligibility criteria for PFS approval, regarding to non-owner occupied homes. In ML 2008-43, the subject properties must have not been rental homes for more than 18 months prior to PFS acceptance. In ML 2013-23, all non-owner-occupants with more than 90 days delinquent and credit score less than 620 are qualified for streamlined PFS. Also the consideration fee was increased from \$1,000 to \$3,000 to give borrowers more incentive to take this program. In 2014, the updated PFS guideline in ML 2014-15³¹ required a minimum marketing period of 15-calendar days for all PFS transactions. It also clarifies that non-arms-length transaction are permitted only if it is necessary to comply with the state law.

In November 2011, FHA started a pilot program allowing Third Party Sale (TPS) auctions as an alternative to REO disposition. The pilot program was expanded into a national program in 2013. By the end of May 2013, nine major national lenders signed into the implementation of the TPS program. In 2014, to encourage TPSs, HUD reimburses mortgagees for third-party service fees that incur for an amount that does not exceed five percent of a property's net sales price. Also, bidding instructions have changed to "align net expected recoveries in REO with the appraised value of the property to provide at minimum break-even bidding prices for FHA's interest in the property,"³² which would improve TPS efficiency. Also HUD is further requiring servicers to "use the Commissioner's Adjusted Fair Market Value (i.e., which will be made available to mortgagees) as the Reserve Price at the foreclosure sale when the qualification criteria, referenced herein, are met."³³ These new policy initiatives are expected to result in additional TPS Claim filings, and could help reduce loss severity by avoiding the additional carrying and disposition costs in an otherwise identical REO case.

Starting from 2009, FHA has aggressively engaged in loan modification program, including rate reduction, term extension and principal forbearance, in addition to traditional repayment plans. The post modification data has been included in the loan status transition model to accurately capture the future behavior for modified loans.

²⁹ Mortgagee Letter 2008-43, December 24, 2008, Pre-Foreclosure Sale (PFS) Program - - Utilizing the PFS Loss Mitigation Option to Assist Families Facing Foreclosure.

³⁰ Mortgagee Letter 2013-23, July 9, 2013, Updated Pre-Foreclosure Sale (PFS) and Deed in Lieu (DIL) of Foreclosure Requirements

³¹ Mortgagee Letter 2014-15, July 10, 2014, Updated Requirements for Pre-Foreclosure Sales (PFS) and Deeds in Lieu (DIL) of Foreclosure.

³² U.S. Department of Housing and Urban Development, December 13, 2013, Annual Report to Congress Regarding the Financial Status of the FHA Mutual Mortgage Insurance Fund Fiscal Year 2013.

³³ Mortgagee Letter 2014-XX, TBA, Increasing Opportunities for Use of FHA's Claims Without Conveyance of Title (CWCOT).

In June 8, 2012 press release,³⁴ HUD announced the Distressed Asset Securitization Program. “Under the program, FHA-insured notes are sold competitively at a market-determined price generally below the outstanding principal balance. Once the note is purchased, foreclosure is delayed for a minimum of six additional months as the borrower gets direct help from their servicer to help to find an affordable solution to avoid foreclosure.”

As this Review was produced, HUD has already completed its fifth, multi-billion dollar sale of single-family non-performing loans in the past eighteen months.³⁵

C. Current and Future Market Environment

1. Interest Rates

Due to the current weak economy and the Fed’s active monetary policies, the one-year Treasury rate has fallen to a historically low level: from 2.18 percent in August 2008 to 0.10 percent in July 2014. Similarly, the ten-year Treasury yield also declined from 3.59 percent in August 2009 to 2.48 percent in July 2014. The average conventional 30-year fixed-rate mortgage commitment rate posted by Freddie Mac also declined from 5.19 percent in August 2009 and to 4.13 percent in July 2014. These realized 2014 rates are lower than those projected in last year’s Review.

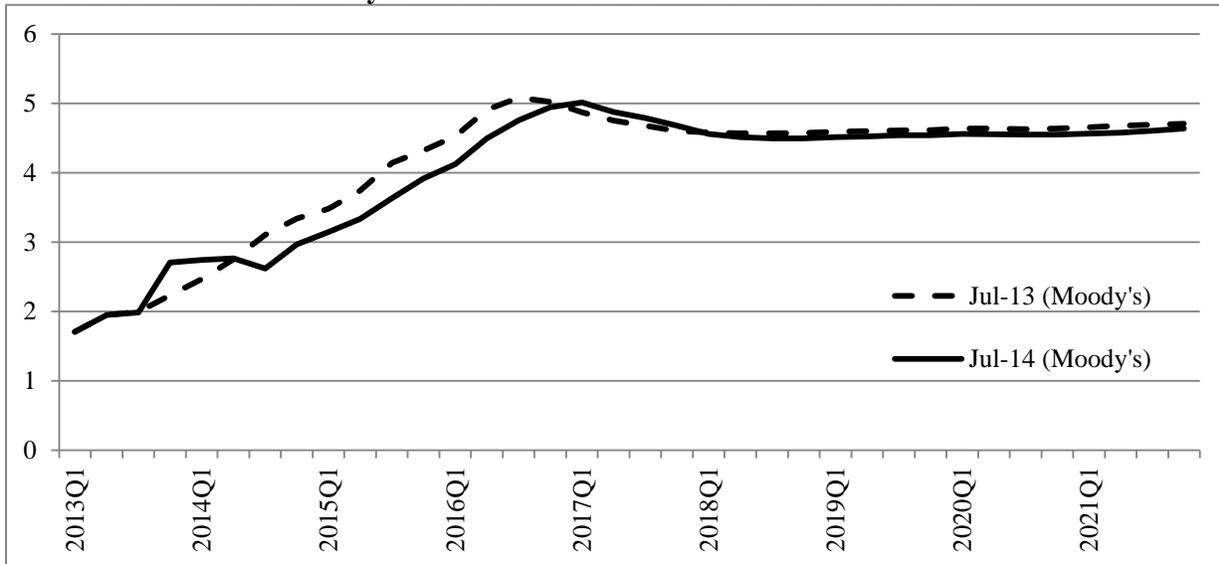
Moody’s July 2014 economic forecast projected that future mortgage rates will steadily rise to 6.34 percent by Calendar Year (CY) 2016Q4, and then stabilize around 6.13 percent afterward. Compare to last year’s Moody’s forecast, the mortgage rates will be rising by slower speed and then stay at a higher level. The one-year Treasury rate was projected to rise slowly to 0.60 percent by CY 2015Q4, then quickly rebound to about 3.90 percent in the following six years, and stay the level in the future. The ten-year Treasury rate was projected to rise to 5.01 percent by CY 2016Q4. Moody’s July 2014 forecasted rates for the one-year Treasury rate, the ten-year Treasury rate and mortgage rates to rise slower than those in the July 2013 forecast.

Exhibit I-1 shows forecasts of the 10-year Treasury rate used this year and in prior-year Reviews. As mentioned, the realized 10-year Treasury rates during the past year turned out to be much lower than what were forecasted in the previous year. This is due to the persistent economic vulnerability and the extension of quantitative easing policies of the Federal Reserve.

³⁴ HUD Press Release No. 12-096, June 8, 2012, HUD to Expand Sale Of Troubled Mortgages Through Program Designed to Help Borrowers Avoid Costly, Lengthy Foreclosures.

³⁵ https://www.debt.com/content/c551/4.8_Billion_in_Nonperforming_HUD_Loans_Head_to_Market.pdf

Exhibit I-1: 10-Year Treasury Rate Forecasts for the Current and Prior Review



2. House Price Growth Rates

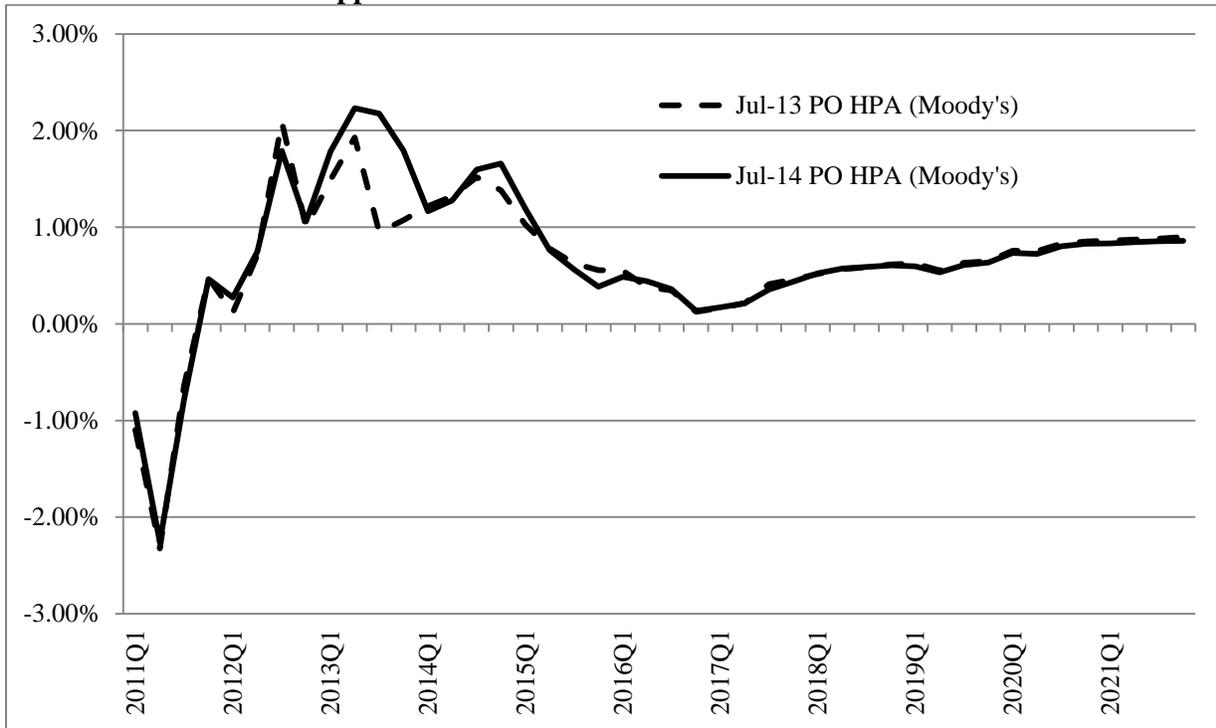
Federal Housing Finance Agency (FHFA) published the Purchase-Only (PO) Home Price Index of 75 MSAs for the first time in 2013. This allowed us to replace the all-transaction HPI which was used in earlier Reviews. The PO Index is based on repeat sales of actual housing sale prices and does not involve any appraised values. As such it provides a more direct and accurate measure of housing market conditions.

Moody’s forecasts the PO HPI at the local level, including metropolitan areas and states. Moody’s publishes its forecasting methodology and provides a description of the rationale behind their assumptions. In addition to their baseline forecast, Moody’s also provides alternative scenarios, one of which we used in Section V.

Exhibit I-2 presents the July 2014 Moody’s baseline national house price growth rate forecast as compared to the one used in the 2013 Review. According to this year’s forecast, the annualized national house price growth rate is 6.80 percent through the fourth quarter of FY 2014. Then the rate drops to positive 0.54 percent per annum by the fourth quarter of FY 2016, representing a minor recession. After that, the house price growth rate gradually rises to a long-run average annual rate of around 3.50 percent.

Importantly, the Exhibit I-2 shows the upward trend for the nation’s housing market over the past year.

Exhibit I-2: House Price Appreciation Forecasts for FY 2013 and FY 2014



3. Mortgage Demand

FHA’s market share has increased dramatically from its low of 2.04 percent in FY 2007. Before that time, FHA’s market share declined in concert with the expansion of the subprime mortgage market (2003-2007). As a result of the financial crisis of 2008, capital left the subprime mortgage market. Private mortgage insurers also became capital-constrained after facing heavy losses. Thus, FHA had become the primary source for high-LTV lending, with a share of 8 percent to 12 percent of the entire single-family first-lien mortgage market during the past two years. Origination volume during FY 2009 reached a record high of \$330 billion, up from \$176 billion in FY 2008. The FY 2010 volume was \$295 billion and the volume for FY 2011 was \$214 billion, while FY 2012 continued to be a high volume year with \$218 billion. The FY 2013 volume was \$235 billion, which is only second to FY 2009 and FY 2010, due to the record low mortgage interest rate. The estimate for the FY 2014 volume is \$134 billion, due primarily to the rising mortgage rate in first half of this year.³⁶

³⁶Based on FHA data warehouse as of the end of June 2014.

Any forecast of future FHA endorsement volumes depends critically on what the future holds for conventional mortgage lenders, private mortgage insurers, Fannie Mae and Freddie Mac. If these institutions reestablish their prior roles and levels in the markets, FHA market share would likely revert to its historical norm of around 8 to 10 percent. With an assumed prolonged impairment of the role of other mortgage market institutions, we project the FHA market share to settle to around 15 percent of the total single-family mortgage market.

Moody's July 2013 baseline scenario projects positive near-term house price growth at the national level and a near-term rapid rise in mortgage rates. These factors lead us to estimate a reduction of FHA volume to \$126 billion in FY 2015. We then expect FHA endorsement volume to revert to the \$140 billion range for FY 2018 and beyond, given Moody's baseline scenario for the economy and the housing market.

D. Structure of this Report

We again emphasize that the results reported in this Review pertain to the MMI Fund performance excluding HECMs.

The remainder of this report is divided into the following sections:

Section II. Summary of Findings and Comparison with FY 2013 Actuarial Review – presents the Fund's estimated economic value and insurance-in-force for FY 2014 through FY 2021. This section also provides a reconciliation and explanation of the major differences between the FY 2013 and FY 2014 Reviews.

Section III. Current Status of the MMI Fund – presents the estimated economic value and IIF for the Fund at the end of FY 2014 and provides an analysis of the performance of the FY 1985 through FY 2014 books of business.

Section IV. Characteristics of the Fiscal Year 2014 Insurance Portfolio – describes the FY 2014 insurance portfolio and compares the risk characteristics of the origination books of business across historical fiscal years.

Section V. Fund Performance under Alternative Scenarios – presents analysis of the Fund performance using a range of alternative economic environments.

Section VI. Summary of Methodology – presents an overview of the econometric and cash flow models used in the Review.

Section VII. Qualifications and Limitations – describes the main assumptions and the limitations of the data and models relevant to the results presented in this Review.

Section VIII. Conclusions – provides a summary of the report's results and the conclusions we draw from those results.

Appendix A. Econometric Analysis of Mortgage Status Transitions and Terminations – provides a technical description of our econometric models of claim and prepayment for individual mortgage product types.

Appendix B. Cash Flow Analysis – provides a technical description of our cash flow model.

Appendix C. Data for Loan Performance Simulations – explains the procedures used to transform the raw data into the data used to simulate future mortgage and Fund performance.

Appendix D. Economic Forecasts – describes the forecast of future economic factors that affect the performance of the Fund and the alternative economic scenarios underlying the selected sensitivity analyses.

Appendix E. Loss Severity Model – provides a technical description of our econometric model of FHA mortgage loss severity rates.

Appendix F. FHA Volume Model – explains our econometric model used to project future FHA loan volumes.

Appendix G. Stochastic Simulation – provides a technical description of the econometric model developed to project house price appreciation, and interest rate and unemployment rate changes into the future.

Appendix H. Historical and Projected Loan Termination Rates – contains historical and projected claim and prepayment rates.

Section II: Summary of Findings and Comparison with FY 2013 Actuarial Review

This section presents the economic value and insurance in force of the Fund³⁷ as the end of FY 2014 and provides an explanation of how the economic value of this year's Review compares with that of the FY 2013 Review.

A. The FY 2014 Actuarial Review

The FY 2014 Actuarial Review estimates the economic value of the Fund as of the end of FY 2014 (September 30, 2014) and projects the status of the Fund through FY 2021. The objectives of our analysis include:

- Evaluating the historical experience of the Fund, including loan termination experience due to claims and prepayments, and losses associated with claims;
- Projecting future loan termination rates and their corresponding cash flows of the existing Fund portfolio and of future books of business and
- Estimating the economic value and the insurance-in-force of the Fund.

We conducted this Review by analyzing the historical loan performance using data provided by FHA, developing econometric models and estimating their parameters, and making forecasts of future economic conditions. Econometric models were used to project the future cash flows of the Fund and their present value was combined with estimates of capital resources to estimate the economic value of the Fund.

The econometric models are similar in many respects to those of the FY 2013 Review, but with some enhancements implemented for the current Review. These enhancements include:

- Dynamic simulation of future streamline refinance (SR) loans: instead of creating newly originated SR loans without regard to their original fully underwritten mortgage, we now implement dynamic simulation to generate SR originations from current loans as they are predicted to transition to SRs, so to better forecast the behavior of the SR loans by carrying over information on their previous loans.
- Transition Model improvements: we introduced a first-time buyer indicator as a new explanatory variable. We also introduced two dummy variables that interact the first-time buyer indicator with the front-end debt-to-income ratio above and below 30%.

³⁷ The Fund in this Review refers to the MMI Fund excluding HECMs.

The estimation of the loan status transition models utilizes loan-level data on the Fund's experience recorded by HUD since FY 1996 and extending through the second quarter of FY 2014. The performance of the loans during the recent housing recession enabled us to refine the econometric estimation results, especially for the most-stressed locations.

Appendices A through H describe the individual models, the assumptions used and the econometric results in detail. Our main findings are as follows:

- As of the end of FY 2014, the Fund is projected to have an estimated economic value of **\$5.93 billion**, an unamortized insurance-in-force of **\$1,154.82 billion** and an amortized insurance-in-force of **\$1,059.93 billion**.
- The FY 2014 book of business is projected to contribute an estimated **\$11.79 billion** in present value to the economic value of the Fund.

Our current projections indicate that the Fund's economic value will increase in the future, rising by an average of 51.27 percent per year through FY 2021. With the expected slower prepayment rates of the existing books of business caused by projection of rapidly rising interest rates, the continuation of a relatively high FHA market share and a strong housing market recovery, the IIF is expected to increase by an average rate of 3.01 percent per year through FY 2021. The economic value is expected to grow at a substantially faster rate than that of the IIF. Exhibit II-1 provides estimates of the Fund's economic value and IIF through the end of FY 2021. In summary, the economic value is projected to steadily increase over the next 7 years to reach \$80.54 billion by the end of FY 2021.

Exhibit II-1: Projected Fund Performance for FY 2014 to FY 2021 (\$ Millions)

Fiscal Year	Economic Value of the Fund ^a	Unamortized Insurance in Force ^b	Amortized Insurance in Force ^b	Economic Value of Each New Book of Business	Volume of New Endorsements ^c	Investment Earnings on Fund Balances
2014	5,932	1,154,818	1,059,925	11,788	134,000	
2015	16,161	1,158,756	1,049,949	10,213	124,505	17
2016	24,201	1,184,196	1,060,024	7,851	113,488	189
2017	33,022	1,220,041	1,079,960	8,275	119,065	547
2018	43,780	1,264,146	1,107,688	9,712	136,883	1,046
2019	55,330	1,311,234	1,137,046	9,856	141,338	1,695
2020	67,349	1,362,153	1,168,977	9,747	147,547	2,272
2021	80,541	1,420,350	1,207,055	10,364	159,462	2,828

^a All values are as of the end of each fiscal year. The economic value for FY 2014 through FY 2021 is equal to the economic value of the Fund at the end of the previous year, plus the current year's interest earned on the previous year's capital resources, plus the economic value of the new book of business.

^b Estimated based on the data extract as of June 30, 2014 and projections of new endorsements and loan performance.

^c Based on our volume forecast.

B. Change in the Economic Value of the Fund

Exhibit II-2 displays the components leading to our estimate of the Fund's current economic value, with comparisons between values in the FY 2013 and FY 2014 Reviews. The FY 2013 Review estimated that the Fund had *negative* \$7.87 billion in economic value at the end of FY 2013.

The total capital resources number provided by FHA is \$19.62 billion at the end of FY 2014. The present value of future cash flows is estimated to be *negative* \$13.68 billion. Thus, as of the end of FY 2014, the Fund is estimated to have an economic value of \$5.93 billion.

Exhibit II-2: Estimates of Fund Economic Value as of the End of FY 2014 (\$ Millions)

Item	End of FY 2013 ^a	End of FY 2014
Cash	\$ 39,629	
Investments	0	
Properties and Mortgages	2,735	
Other Assets and Receivables	371	
Total Assets	\$ 42,735	
Liabilities	(22,173)	
Total Capital Resources	\$ 20,561	
Net Gain from Investments		\$ 587 ^b
Net Insurance Income in FY 2014		(3,880) ^c
Net Change in Properties and Mortgages		768 ^b
Net Change in Accounts Payable		810 ^b
Transfer from HECM Financing Account		770 ^b
Total Capital Resources		\$ 19,616
PV of Future Cash Flows on Outstanding Business		(13,684)
Economic Value	\$ (7,871)^d	5,932
Unamortized Insurance-In-Force	1,173,038 ^d	1,154,818
Amortized Insurance-In-Force	1,090,482 ^d	1,059,925

^a Source: Audited Financial Statements for FY 2013.

^b Based on audited investment income provided by FHA.

^c Based on audited net non-HECM operating cash flow through the end of FY2014 provided by FHA.

^d From the FY 2013 Actuarial Review.

As seen in Exhibit II-2, the estimated FY 2014 economic value of the Fund increased by \$13.80 billion from the FY 2013 level of *negative* \$7.87 billion to \$5.93 billion. The IIF slightly decreased by 1.55 percent – from \$1,173.04 billion to \$1,154.82 billion. The change in the estimated economic value represents the net impact of several significant factors, which are described in detail below.

C. Sources of Change from the FY 2013 Review to the FY 2014 Review

This section describes the sources of change in estimates of economic value between this year's Review and last year's Review for FY 2014 and FY 2020. Separating out the specific impacts can be done only up to a certain degree of accuracy, because it depends on the order in which the decomposition is done. The interdependency among the various components of the analysis prevents us from identifying and analyzing these as purely independent effects. With this caveat, this section presents an approximate decomposition of differences in the FY 2014 and FY 2020 economic values from those presented in the FY 2013 Review, by source of change.

1. Change in Economic Value from FY 2013 to FY 2014

The FY 2013 Review estimated the economic value of the Fund as of the end of FY 2013 to be *negative* \$7.87 billion and the projected FY 2020 economic value to be \$84.87 billion. In this Review, we estimate the end-of-FY 2014 economic value for the Fund to be \$5.93 billion, which represents an increase of \$13.80 billion from the FY 2013 economic value reported in the FY 2013 Review. This is a significant increase in the estimated economic value of the Fund. Accompanying this increase in economic value is a decrease in the unamortized IIF of 1.55 percent.

2. Current Estimate of FY 2014 Economic Value Compared with the Estimate Presented in the FY 2013 Actuarial Review

The FY 2013 Review projected that the FY 2014 investment earnings on Fund balances and the present value of the FY 2014 book of business would add *negative* \$0.02 billion and \$15.73 billion, respectively, to the economic value of the Fund, resulting in a projected FY 2014 economic value of \$7.84 billion. As shown in Exhibit II-2, with the updated financial statements and data extract we now observe the end-of-FY 2013 capital resources to be \$20.56 billion and the total net change in capital resources in FY 2014 to be *negative* \$0.95 billion, thus the end-of-FY 2014 capital resources is \$19.62 billion. Details on the net income in FY 2014 are provided in Section III of this Review. Combining the capital resources with the estimated present value of future cash flows of the outstanding portfolio of *negative* \$13.68 billion, this year's estimate of the FY 2014 economic value is \$5.93 billion. Thus, this year's estimate of the FY 2014 economic value is \$1.91 billion lower than the economic value of \$7.84 billion projected for FY 2014 in last year's Review, as shown in Exhibit II-3.

Exhibit II-3 also provides a summary of the decomposition of changes in the current economic value of the Fund as of the end of FYs 2014 and 2020 from the FY 2013 Review as compared to the FY 2014 Review. The overall net change in economic value, reflecting several offsetting factors, is negative for both FY 2014 and for FY 2020.

Exhibit II-3: Changes in Fund Estimated Economic Value Between FY 2013 and 2014(\$ Millions)

	Change in FY 2014 Economic Value	FY 2014 Economic Value ^a	Change in FY 2020 Economic Value	FY 2020 Economic Value ^b
FY 2013 Economic Value Presented in the FY 2013 Review		-7,871		
FY 2014 Economic Value Presented in the FY 2013 Review, Excluding the FY 2014 Book of Business:	-16	-7,886		
Plus: Forecasted Economic Value of FY 2014 Book of Business Presented in the FY 2013 Review	15,725			
Equals: FY 2014 Economic Value Presented in the FY 2013 Actuarial Review		7,838		84,866
Plus: a. Fund Transfer from HECM Financing Account	770	8,608	866	85,733
Plus: b. Update Origination Volume of FY 2013 and FY 2014	-4,691	3,917	-5,277	80,455
Plus: b1. Update Volume Forecast of FY 2015 and Later Books of Business	0	3,917	-9,981	70,474
Plus: c Update FY 2014 Discount Factors	102	4,019	-1,215	69,259
Plus: d. Update Actual Performance in FY 2013-FY 2014	1,271	5,290	1,475	70,734
Plus: e. Update Econometric Models	-2,838	2,452	972	71,706
Plus: f. Update Economic Scenario Forecast	1,699	4,151	-6,752	64,954
plus: g. Update Loss mitigation cost	-458	3,692	-770	64,184
Plus: h. Adjustment for Inventory of Delayed Claims	-7	3,685	-9	64,175
Plus: i. Adjustment for June and September Note Sale Transactions	273	3,958	316	64,491
Plus: j. Adjustment for 2014 Third Party Sales	1,212	5,170	1,970	66,461
Plus: k. Adjustment for Future Note Sale	762	5,932	889	67,349
Equals: Estimate of Economic Value	-1,906	5,932	-17,517	67,349

^a Shows the progression of economic values as of the end of FY 2014 as incremental changes are made.

^b The FY 2020 economic values are the latest year that can be directly compared between the FY 2013 and FY 2014 Reviews.

3. Decomposition of the Differences in Economic Value of the Current Review versus the FY 2013 Review

We now present a step-by-step analysis of the differences between the FY 2013 and FY 2014 Reviews, shown in Exhibit II-3.

a. Fund Transfer from HECM Financing Account

In 2014, FHA made a transfer of \$0.77 billion from HECM financing account. This change increases the FY 2014 economic value by the corresponding amount and increases the FY 2020 economic value by \$0.87 billion due to compound interest.

b. Update Origination Volume of FY 2013 and FY 2014

The second component of change depicted in Exhibit II-3 relates to the updated origination volume and composition for the FY 2013 and FY 2014 books of business. The actual realized origination volume of the FY 2013 book and updated estimate of the FY 2014 book as of September 2014 are lower than what were projected in last year's Review. The greater realized volume caused a decrease of \$4.69 billion in the estimated FY 2014 economic value. The projected economic value due to the updated volume and composition projections through FY 2020 was also lower by \$5.28 billion.

b1. Update Volume Forecast of FY 2015 and Later Books of Business

The third element of change in Exhibit II-3 is the change in the forecasted FHA endorsement volume of FY 2015 and later books of business. This step has no impact on the estimated FY 2014 economic value, but negatively impacts the estimated FY 2020 economic value by \$9.98 billion.

c. Update FY 2014 Discount Factors

The Office of Management and Budget (OMB) discount factors are used to discount the projected cash flows to their present values. The OMB FY 2015 discount rates are higher than the discount factors used in last year's Review, thus reducing the magnitude of NPVs of future cash flows. Updating the discounting factors causes the estimated FY 2014 economic value to increase by \$0.10 billion and the estimated FY 2020 economic value to decrease by \$1.22 billion. The existing book has a high volume of past books with negative NPVs, which would improve due to higher discounting rate. The future books of FY 2015-2021 all have positive NPVs, which would suffer due to higher discounting rates. Thus updating the discount factors has asymmetric impact on existing books and future books.

d. Update Actual Performance in FY 2013- FY 2014

The projected economic value change in FY 2014 and FY 2020 due to the update of the actual performance in FY 2013 and FY 2014 was *positive* \$1.27 billion and *positive* \$1.48 billion, respectively.

e. Update Econometric Models

As a result of our continuing effort to improve the accuracy of the analysis, several model enhancements were implemented this year. The major changes include (1) model structure update, (2) addition of new explanatory variables, (3) new specifications of existing variables, (4) loss severity and (5) volume forecast.

We added the following new variables into the transition models:

- First-time buyer indicator to capture the information whether the borrower was a first-time home buyer
- Two dummy variables interacting the first-time buyer indicator with the front-end DTI ratio

For details about these model enhancements, refer to Appendices A, E and F.

These and other modeling changes led to a decrease in estimated economic value in FY 2014 by \$2.84 billion, and an increase in estimated economic value of \$0.97 billion in FY 2020.

f. Update Economic Scenario Forecast

For this decomposition analysis, we updated the purchase-only HPI and interest rates forecast from Moody's July 2013 forecast to July 2014. Due to the stronger than forecasted HPA during the last three quarters of FY 2013, the average equity in the house of all current portfolio loans increased. The improved equity position in the house reduces the default probability, which leads to improvement of future cash flows. On the other hand, the interest rate turned out to be lower than what were projected in FY 2013 Review. The lower interest rates imply slower prepayment rate and longer annual premium income, which also improves the economic value of the existing portfolio. The impacts of this change are an increase of \$1.70 billion in the estimated FY 2014 economic value and a decrease of \$6.75 billion in the estimated FY 2020 economic value.

g. Update Loss mitigation cost

Due to the dramatic increase of loan loss mitigation cases from FY 2007 to FY 2013, the estimated loss mitigation cost share in total claim loss has increased from 5.80 percent to 6.63

percent. The impacts from this model change is a decrease of \$0.46 billion in the estimated FY 2014 economic value and a decrease of \$0.77 billion in the estimated FY 2020 economic value.

h. Adjustment for Inventory of Delayed Claims

Our model projected more claims than actually occurred over FYs 2013 and 2014. This is a consequence of the delay by servicers in the foreclosure process and in filing claims since the late FY 2009 moratorium. As a result of this delayed claim phenomenon, there is an unusually large inventory of loans deep into the foreclosure process or even with complete auctions that had no claims filed when this Review was prepared. These loans in the foreclosure process should have already been claimed by now under normal market operations. However, they continue to remain in the Fund as non-performing loans with no losses yet recorded. We projected that the industry will accelerate the claim filing process to reduce this excess foreclosure inventory. To reflect this effect, we identified 20,950 loans that have already been foreclosed but without filed claims. We assume that all these loans will be claimed based on a state-level empirical distribution estimated from historical data, starting from FY 2014Q4. This state-level estimation is based on all loans that terminated between fiscal quarters 1990Q1 through 2014Q2.³⁸ Please refer to Appendix B for the estimation details. This adjustment resulted in \$0.01 billion lower FY 2014 and FY 2020 economic values.

i. Adjustment for June and September Note Sale Transactions

Since there are two sets of note sales falling into the near forecast period (2014Q3 to 2015Q1), we have implemented a note sale override schedule to account for the note sale transactions. There are altogether 37,856 loans that need to be overridden with new loss severity numbers, which are considerably lower than the REO loss severity rate. Therefore, the economic value of FY 2014 has been improved by \$0.27 billion and the economic value of FY 2020 has been increased by \$0.32 billion.

j. Adjustment for 2014 Third Party Sales

In November 2011, under a pilot program, FHA started allowing Third Party Sale (TPS) auctions as an alternative to REO disposition. The pilot program was expanded into a national program in 2013. By the end of May 2013, nine major national lenders signed into the implementation of the TPS program. Conceptually, a TPS execution could help reduce loss severity by avoiding the additional carrying and disposition costs in an otherwise identical REO case.

Based on the recent trend of TPS disposition and the historical experience of GSEs which have consistently used this type of program, we project that the share of TPS, as a percentage of the model projected foreclosure liquidations would stay at the current level of 25 percent starting

³⁸ Data source: FHA default episode datasets.

from fiscal quarter 2014Q3. We further assume that TPS liquidation would have a 22.5 percent haircut, compared to standard REO sales. Based on these assumptions, the distressed asset securitization program is estimated to increase FY 2014 economic value by \$1.21 billion and increase FY 2020 economic value by \$1.97 billion.

k. Adjustment for Future Note Sale

We assume the note sale share in total claim terminations and the loss severity rate will maintain the current level from 2015Q2 to 2017Q1. We also assume that the REO claim amount will be reduced by 75 percent of the estimated note sale amount and the TPS claim will be decreased by the rest 25 percent of the note sale. Therefore, the economic value of FY 2014 has been increased by \$0.76 billion and the economic value of FY 2020 is increased by 0.89 billion.

Section III: Current Status of the MMI Fund³⁹

As of the end of FY 2014, the Fund has an estimated economic value of \$5.93 billion. The estimated economic value at the end of FY 2013 was *negative* \$7.87 billion. The current estimated economic value is \$13.80 billion higher than what it was at the end of FY 2013 and \$1.91 billion lower than the \$7.84 billion economic value projected for FY 2014 in the FY 2013 Review. At the same time, the unamortized IIF of the Fund decreased 1.55 percent, from \$1,173.04 billion in FY 2013 to \$1,154.82 billion in FY 2014.

In this section, we present an analysis of the Fund's current status. The analysis examines the status of the Fund at the end of FY 2014 and the projected future performance of new books of business through FY 2021. This section describes the basic components of the Fund's economic value and how they are expected to change through FY 2021.

A. The Current Economic Value of the Fund

According to the NAHA legislation, the economic value of the Fund is defined as the "cash available to the Fund, plus the net present value of all future cash inflows and outflows expected to result from the outstanding mortgages in the Fund." We base our estimate of this value on the level of capital resources projected for the end of FY 2014 plus the present value of expected future cash flows of the existing loan portfolio as estimated by our financial models. This year we still projected the cash flows based on a Monte Carlo simulation of 100 possible future economic scenarios that are centered on Moody's baseline economic projections. Our estimate was computed as the average economic value from each of these 100 simulated paths. See Appendix G for more details about this stochastic Monte Carlo approach.

The present value of expected future cash flows is calculated based on a financial model that uses the most current information available to estimate future cash inflows and outflows. Cash inflows include upfront and annual premiums and projected investment income. Cash outflows include net claim losses, premium refunds and loss mitigation expenses. These calculations include all cash flows that occur from the valuation date to the termination of the loan or the scheduled maturity (*e.g.*, 30 years for 30-year mortgages).

³⁹ The MMI Fund in this Review refers to MMI Fund excluding HECMs.

1. Capital Resources

Capital resources are the net assets of the Fund that, if necessary, could be converted into cash to meet the Fund's obligations, including payment of claims as they arise. They are computed by subtracting total liabilities from total assets. The assets consist of cash, Treasury investments, properties, mortgages, other assets and miscellaneous receivables net of payables. Exhibit III-1 indicates that the Fund's audited capital resources at the end of FY 2013 was \$20.56 billion.

The next step in estimating the capital resources as of the end of FY 2014 is to estimate the sources and uses of funds generated by the Fund so as to compute the net change in funds over the year. These include the following five factors:

- (1) Net gain/loss from investment: a net gain of \$0.59 billion for FY 2014.
- (2) Net insurance cash flow in FY 2014: the net cash flow is computed as the sum of upfront and annual premium revenues, claim loss payments, premium refunds and loss-mitigation-related expenses, with the last three being negative cash flows. The resulting insurance-related cash flow for FY 2014 was estimated to be *negative* \$3.88 billion.
- (3) The real estate owned (REO) and mortgage inventory was estimated to increase by \$0.77 billion in FY 2014.
- (4) A net change in accounts payable of *negative* \$0.81 billion.
- (5) A transfer from the HECM Financing Account of \$0.77 billion.

From these five factors the total change in capital resources for the year is a reduction of \$0.95 billion. As a result, the capital resources of the Fund as of the end of FY 2014 were estimated to be \$19.62 billion.

Exhibit III-1: Estimate of Fund Economic Value as of the End of FY 2014 (\$ Millions)

Item	End of FY 2013 ^a	End of FY 2014
Cash	\$ 39,629	
Investments	0	
Properties and Mortgages	2,735	
Other Assets and Receivables	371	
Total Assets	\$ 42,735	
Liabilities	(22,173)	
Total Capital Resources	\$ 20,561	
Net Gain from Investments		\$ 587 ^b
Net Insurance Income in FY 2014		(3,880) ^c
Net Change in Properties and Mortgages		768 ^b
Net Change in Accounts Payable		810 ^b
Transfer from HECM Financing Account		770 ^b
Total Capital Resources		\$ 19,616
PV of Future Cash Flows on Outstanding Business		(13,684)
Economic Value	\$ (7,871)^d	5,932
Unamortized Insurance-In-Force	1,173,038 ^d	1,154,818
Amortized Insurance-In-Force	1,090,482 ^d	1,059,925

^a Source: Audited Financial Statements for FY 2013.

^b Based on audited investment income provided by FHA.

^c Based on audited net non-HECM operating cash flow through the end of FY2014 provided by FHA.

^d From the FY 2013 Actuarial Review.

2. Present Value of Future Cash Flows in FY 2014 and Future Years

The present value of future cash flows of the Fund is aggregated from separate estimates of the present value of future cash flows from each book of business and for each of the six major mortgage product types. Exhibit III-2 shows the present values of future cash flows for each of the six mortgage product types from the FY 1985 through the FY 2014 books of business that have survived to the end of FY 2014. The present values are computed from the projected cash flows occurring during FY 2015 and future years. They are computed by taking the average over a set of simulated economic scenarios. This exhibit is offered to facilitate comparison among books of business and mortgage types based on cash flows that have not yet been realized as of the end of FY 2014. From Exhibit III-2, the total present value of these future cash flows is *negative* \$13.68 billion. Compared to the corresponding figure estimated in the FY 2013 Review, the current liability decreased by \$14.75 billion.

The sharply negative house price growth rates from 2007 to 2011 suggest that mortgages originated during the years from 2005 through 2009 are likely to face higher claim rates. Given that their upfront premiums were already collected and are included as part of the current capital resources, and due to their large origination volume, the FY 2008 and FY 2009 books are estimated to experience larger negative present values than any other book, *negative* \$7.33 billion and *negative* \$9.26 billion, respectively. However, at the end of the housing recession, house prices bottomed out and turned slightly positive, giving the FY 2011 through FY 2014 books a positive initial start, and their present values are positive, event excluding the upfront premiums.

Exhibit III-2: Present Value of Future Cash Flows by Origination Fiscal Year & Mortgage Type as of the End of FY 2014 (\$ Millions)

Fiscal Year	FRM 30	FRM 15	ARM	SR 30	SR 15	SR ARM	Total
1985	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0
1987	-1	0	0	0	0	0	-1
1988	-1	0	0	0	0	0	-1
1989	-1	0	0	0	0	0	-2
1990	-2	0	0	0	0	0	-2
1991	-3	0	-1	0	0	0	-4
1992	-4	0	-4	-1	0	0	-9
1993	3	0	-4	-6	0	-1	-8
1994	5	0	-9	-11	0	-1	-16
1995	-1	0	-10	-1	0	0	-12
1996	-4	0	-16	-4	0	0	-25
1997	-10	0	-32	-1	0	-1	-44
1998	-24	0	-23	-14	0	-1	-62
1999	-55	0	-15	-29	0	-3	-102
2000	-98	0	-36	-3	0	-2	-139
2001	-263	0	-15	-62	0	-4	-344
2002	-437	0	-65	-111	0	-23	-636
2003	-907	-1	-70	-530	-2	-35	-1,545
2004	-1,361	-1	-181	-304	-1	-60	-1,908
2005	-1,203	-2	-255	-217	-1	-51	-1,729
2006	-1,720	-4	-96	-115	0	-5	-1,940
2007	-2,680	-7	-62	-161	0	-3	-2,913
2008	-6,438	-27	-142	-700	-2	-23	-7,332
2009	-5,169	-31	-116	-3,806	-11	-123	-9,255
2010	-2,685	-24	-390	-1,782	-9	-279	-5,169
2011	1,205	-22	-214	-547	-3	-180	238
2012	3,378	-6	-50	103	-1	-65	3,358
2013	6,406	35	-4	825	21	-20	7,262
2014 ^a	8,477	80	-3	96	10	-5	8,655
Total ^b	-3,592	-11	-1,813	-7,383	0	-885	-13,684

^a Based on projected volume as of August 2014 and FHA's origination composition forecasts.

^b Numbers may not add up due to rounding errors.

3. Amortization of Outstanding Books of Business

Both the unamortized and the amortized IIF are presented in this Review. Exhibit III-3 shows the total volume of new mortgage endorsements for each book of business, the unamortized IIF and the amortized IIF as of the end of FY 2014.

As can be inferred from Exhibit III-3, the FY 2011 through FY 2014 books of business constitute approximately 12.0, 15.2, 19.8 and 12.3 percent of the Fund's total end-of-FY 2014 amortized IIF, respectively. These books will enter their peak default periods during FY 2014 through FY 2018. Given the relative robust quality of these books and the recovery of housing market, the economic value of the fund is expected to improve steadily over the next several years.

After several years of huge endorsement volume after the beginning of the housing recession, the projected endorsement volume of the FY 2014 book declined substantially to the level of early 2000's. The most recent books, i.e. 2011 to 2014, have better credit quality composition than the traditional composition of FHA loans, experienced or expect to experience robust housing market since its origination, and higher annual insurance premium rates. As a result, the FY 2011 to 2014 books of business are projected to generate a positive \$0.24, \$3.36, \$7.26, and \$8.66 billion of the present value of future cash flows to the Fund, respectively as shown in Exhibit III-2. This contrasts to the large negative present values of the pre-FY 2011 books. As these newer cohorts become the dominant component of the outstanding portfolio, the financial strength of the Fund is expected to continue improve in the next several years.

Exhibit III-3: Endorsements and Insurance-in-Force as of End of FY 2014 (\$ Millions)

Book of Business^a	Mortgage Endorsements	Unamortized Insurance-in-Force^b	Amortized Insurance-in-Force^b
1985	24,085	394	25
1986	57,746	1,440	205
1987	70,229	2,088	426
1988	37,427	1,017	296
1989	39,760	918	332
1990	47,125	941	387
1991	44,065	904	415
1992	45,090	1,244	597
1993	73,796	2,114	1,089
1994	79,689	3,005	1,623
1995	41,527	1,322	795
1996	61,694	2,149	1,355
1997	65,466	2,329	1,543
1998	88,591	3,980	2,747
1999	110,063	5,999	4,285
2000	86,803	3,246	2,441
2001	119,890	5,823	4,441
2002	128,890	9,925	7,528
2003	150,584	25,040	18,993
2004	92,894	20,499	16,142
2005	57,711	18,323	15,038
2006	50,138	15,160	13,017
2007	57,667	17,086	15,153
2008	176,108	48,388	43,634
2009	329,825	132,803	120,483
2010	295,403	171,912	157,950
2011	214,189	136,903	127,207
2012	217,864	170,887	161,617
2013	235,041	217,170	209,786
2014 ^c	134,000	131,807	130,374
Total^d	3,233,357	1,154,818	1,059,925

^a End of year insurance-in-force^b Based on June 30, 2014 data extract from HUD and the performance of outstanding loans projected by the econometric models for the fiscal year 2014^c Based on HUD's August 2014 projections.^d Numbers may not add up due to rounding error.

B. Projected Future Economic Values

The economic value of the Fund is projected over FY 2015 through FY 2021 based on: (a) our time-series regression model that projects FHA's mortgage volume, (b) FHA's forecast of future endorsement composition, (c) our stochastic economic forecasts that are centered on Moody's July 2014 economic forecasts and (d) cash flow projections based on the loan status transition, loss severity rate and cash flow models. The initial and subsequent annual economic values of each individual future book of business are first projected, and then by adding these to the projected end-of-period capital resources, the total economic value of the Fund in each year of the forecast period is estimated.

The cash flows associated with future books discounted to the end of each corresponding future fiscal year are presented in Exhibit III-4. Insurance premiums of these future books of business are higher than those on the older books. Also, the baseline economic forecast is more favorable this year than last year. All these changes have positive impacts on the expected present values of the future books.

Exhibit III-4: Present Value of Future Books of Business by Mortgage Type (\$ Millions)^a

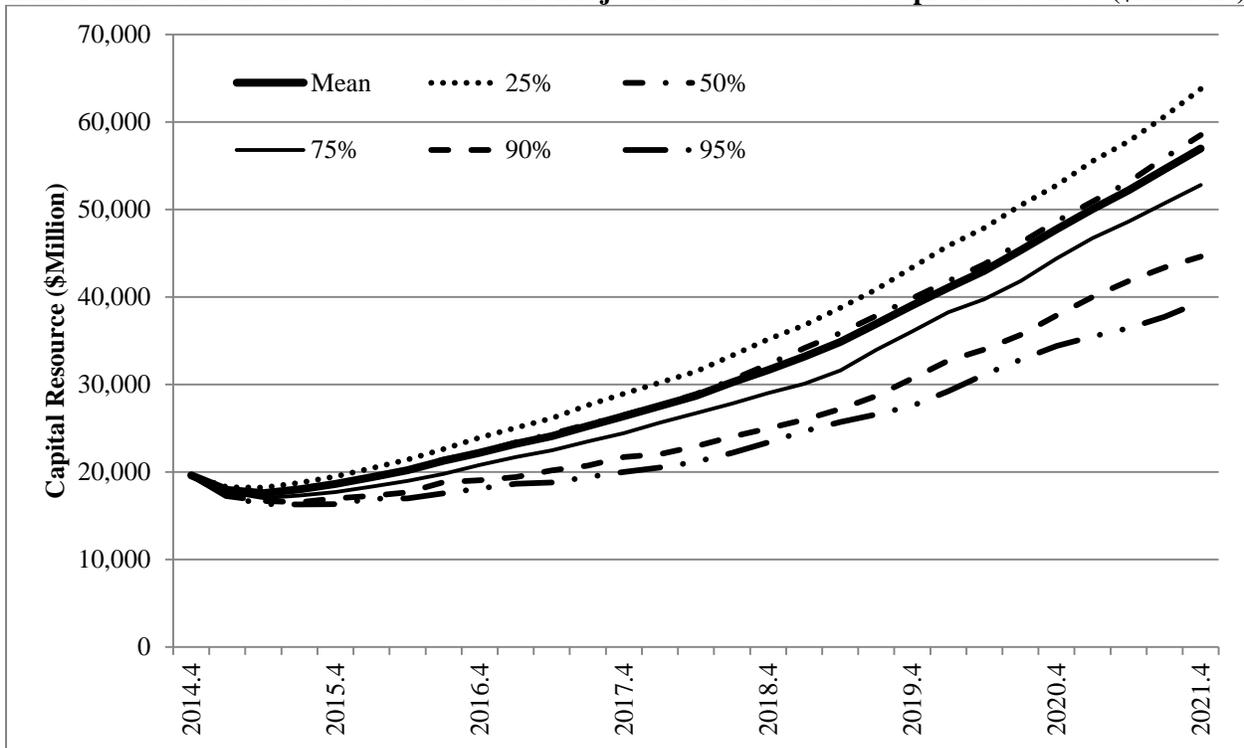
Fiscal Year	FRM 30	FRM 15	ARM	SR 30	SR 15	SR ARM	Total
2015	9,768	128	2	302	7	6	10,213
2016	7,614	105	-22	149	3	2	7,851
2017	7,894	107	0	264	4	6	8,275
2018	8,935	119	26	604	8	19	9,712
2019	9,052	130	-2	644	9	23	9,856
2020	8,963	129	-43	663	10	24	9,747
2021	9,250	133	-7	945	12	30	10,364

^a Present values are estimated as of the end of each respective fiscal year.

C. Projected Future Capital Resources

In this section we project potential movements of future capital resources based on our 100 Monte Carlo simulation paths. All the paths start from the \$19.92 billion of capital resources at the end of FY 2014. Going forward, the capital resources were updated with investment returns and future insurance net cash flows, including upfront premiums, annual premiums, premium refunds, loss mitigation costs, and net claim losses. Exhibit III-5 displays the variations in the capital resources under a wide range of possible economic scenarios, derived according to selected percentiles of our 100-path Monte Carlo simulation. The projected future capital resources in Exhibit III-5 are plotted for the selected percentiles on a quarterly basis. The mean capital resources would reach its lowest point of \$17.58 billion in FY 2015 and recover after that. The capital resources are expected to return to the FY 2014Q4 level by FY 2016Q2. At the 95 percentile worst condition, the capital resources could drop to \$16.28 billion, and they are projected to climb back to \$39.45 billion by the end of FY 2021, which implies that there is less than a 5 percent chance that capital resources drop below \$16.28 billion in the next seven years.

Exhibit III-5: Mean and Selected Percentile Projections of the Fund’s Capital Resources (\$Millions)



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Section IV: Characteristics of the Fiscal Year 2014 Insurance Portfolio

This section analyzes the characteristics of the loan portfolio insured by the Fund at the end of FY 2014.⁴⁰ This discussion covers the following three areas: (1) analysis of the volume and composition of loan types, (2) comparison of new purchase loans versus refinances and (3) the distribution of loans by initial relative loan size, loan-to-value ratios, and borrower credit scores. This section also examines and compares the FY 2014 book with previous books in order to gain insights into how the FY 2014 book is likely to influence the future performance of the Fund. Because the data used for this analysis are an extract as of June 30, 2014, the characteristics for the FY 2014 book reflect only loans originated in the first three quarters of FY 2014 -- between October 1, 2013 and June 30, 2014.

We also examine FHA's business concentration profile to identify indicators that could have significance for the FY 2014 Actuarial Review.

A. Volume and Share of Mortgage Originations

We project FHA to endorse \$134 billion in single-family forward mortgages in FY 2014, bringing the Fund's total unamortized IIF to \$1,154.82 billion. Exhibit IV-1 shows FHA's origination count and volume. The count had dropped significantly from FY 2003 to FY 2007, increased dramatically through FY 2010, then returned to levels similar to those in FYs 2001-2003. The decline and subsequent rise were due, respectively, to the GSEs' and non-conforming lenders' aggressive marketing strategies during the subprime era, and their capital limitations when the bubble burst. FHA's rising volume after the bubble was also partially due to the capital impairment of the private mortgage insurance companies. As the private mortgage insurance industry faces severe capital constraint, the GSEs have been unable to purchase or guarantee loans with less than 20 percent down payment. FHA became the primary source of higher-LTV loans since FY 2009.

The volumes show a similar pattern, for the same reasons cited above, but the post-bubble volumes were much higher than in the early 2000s, because the loan size limits were increased to the levels of the GSEs, so as to serve this part of the market while the private mortgage insurers and non-conforming lenders were constrained by their capital requirements.

⁴⁰ The Fund in this Review refers to the MMI Fund excluding HECMs.

Exhibit IV-1: Total Count and volume of FHA-Insured Originations

Fiscal Year	Count of Originations			Volume of Originations (\$Billions)		
	New purchase	Fully underwritten refinance	Streamline	New purchase	Fully underwritten refinance	Streamline
1983	505,634	249	41	26.80	0.01	0.00
1984	286,913	53	159	15.92	0.00	0.01
1985	399,951	10	670	24.06	0.00	0.03
1986	908,120	19	21,035	56.44	0.00	1.31
1987	981,103	15	145,857	61.02	0.00	9.21
1988	584,240	1	31,589	35.51	0.00	1.92
1989	615,741	5	18,895	38.64	0.00	1.13
1990	689,968	146	25,645	45.54	0.01	1.58
1991	614,050	545	28,961	42.17	0.04	1.86
1992	540,239	2,834	94,090	38.42	0.21	6.47
1993	572,145	16,006	402,892	43.23	1.17	29.40
1994	601,220	13,358	445,317	47.90	0.93	30.86
1995	489,898	5,317	26,052	39.31	0.41	1.81
1996	606,820	29,334	91,931	51.76	2.41	7.53
1997	662,563	30,344	47,321	58.48	2.63	4.36
1998	708,796	56,193	190,526	64.51	5.17	18.91
1999	812,785	70,480	238,499	79.95	6.94	23.18
2000	771,328	35,839	25,947	80.53	3.77	2.51
2001	783,123	69,395	208,255	86.50	8.04	25.35
2002	735,909	82,608	283,132	85.59	10.09	33.22
2003	595,535	97,836	550,200	72.67	12.63	65.29
2004	480,742	67,898	222,481	59.45	9.00	24.45
2005	326,346	43,037	106,084	39.95	5.92	11.85
2006	283,355	71,060	32,214	35.93	10.52	3.68
2007	265,609	123,187	21,266	35.65	18.96	3.06
2008	607,725	379,240	64,136	98.87	66.52	10.73
2009	990,228	504,398	334,808	170.68	92.33	66.90
2010	1,097,282	341,064	213,852	189.65	61.98	43.77
2011	768,264	237,713	173,798	132.76	44.06	37.41
2012	744,692	179,236	286,004	126.36	32.26	59.28
2013	690,499	128,493	500,498	122.90	23.71	88.88
2014 ^a	416,810	57,085	87,484	73.83	9.81	12.26

Source: FHA data warehouse, June 30, 2014 extract.

^a Based on partial year data.

Exhibit IV-2 shows FHA’s origination volume and market share in home purchase mortgages from FY 1995 through FY 2014. The market share in terms of the number of mortgages declined during FYs 2004-2007, then subsequently surged, and then returned to the pre-subprime level.

Exhibit IV-2: FHA’s Market Share in the Home Purchase Mortgage Market

Fiscal Year	Number of Home Sales (Thousands)			Volume of Home Sales (\$Billions)		
	FHA ^a	Market ^b	FHA Share (%)	FHA	Market	FHA Share (%)
1995	556	4,845	11.48	45	689	6.46
1996	686	5,289	12.97	58	784	7.43
1997	751	5,467	13.74	66	854	7.73
1998	789	6,084	12.96	71	1,004	7.12
1999	909	6,463	14.06	89	1,124	7.96
2000	856	6,335	13.52	89	1,157	7.71
2001	869	6,405	13.57	96	1,221	7.87
2002	806	6,615	12.18	94	1,356	6.93
2003	655	7,148	9.16	80	1,578	5.09
2004	505	7,901	6.40	63	1,914	3.28
2005	345	8,454	4.08	43	2,247	1.89
2006	301	7,979	3.77	39	2,201	1.75
2007	288	6,992	4.12	39	1,920	2.04
2008	719	5,688	12.64	118	1,453	8.14
2009	994	5,315	18.70	171	1,196	14.27
2010	1,069	5,589	19.13	183	1,252	14.66
2011	766	5,236	14.63	130	1,148	11.35
2012	734	4,879	15.04	124	1,097	11.30
2013	702	5,489	12.79	125	1,354	9.23
2014 ^c	273	2,297	11.89	49	576	8.51

Sources: FHA Share of Home Purchase Activity Report for cohorts before 2011⁴¹ and Quarterly Report to Congress on FHA Single-Family Mutual Mortgage Insurance Fund Programs for 2012-2014 cohorts.⁴² Existing Home Sales are from the National Association of Realtors. New Homes Sales are from the U.S. Census Bureau and include manufactured housing. FHA numbers are from HUD.

^a Home purchase loans endorsed by FHA under either the General Insurance Fund or the MMI Fund.

^b Total number of home sales in the nation.

^c FY 2014 numbers are through March 2014.

⁴¹ http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/rmra/oe/rpts/fhamktsh/fhamkt

⁴² http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/rmra/oe/rpts/rtc/fhartcqrly

FHA’s market share, which had averaged about 13 percent during the period from FY 1995 through FY 2002, declined to a low of 3.77 percent in FY 2006. This trend has reversed during the next several years and by FY 2008, FHA’s market share was back to 1990’s levels. FHA’s share by loan count increased from 4.12 percent in FY 2007 to 19.13 percent in FY 2010, and its share by dollar volume increased from 2.04 percent in FY 2007 to 14.66 percent in FY 2010. Subsequently, the shares have settled back to a lower level similar to the 1995-2002 period: the partial-year data shows that the FHA share in FY 2014 by loan count was 11.89 percent and the share by dollar volume was 8.51 percent.

B. Originations by Location

FHA insures loans in all regions of the U.S., but about half of FHA’s total dollar volume is concentrated in only ten states. Exhibit IV-3 shows the percentage of FHA’s total dollar volume originated in these ten states from FY 2010 through FY 2014. The states are ordered based on the dollar volume endorsed during FY 2014.

Exhibit IV-3: Percentage of Origination Volume by the Top-10 States

State Location^a	2010	2011	2012	2013	2014
California	15.11	17.47	18.90	17.00	16.27
Texas	6.11	5.99	6.57	7.19	8.89
Florida	4.21	4.27	4.14	4.83	6.09
New York	4.13	4.58	4.21	3.93	4.06
Arizona	2.55	2.56	2.46	2.85	3.52
Virginia	4.08	4.12	3.92	3.79	3.38
Georgia	3.04	2.77	2.79	3.14	3.36
Illinois	3.61	3.28	3.21	3.39	3.24
Colorado	3.11	3.06	3.11	3.27	3.18
Maryland	3.63	3.63	3.50	3.46	3.05

Source: FHA data warehouse, June 30, 2014 extract.

^a States are ranked according to their share of FY 2014 origination volume in the Fund.

The percentage share of FHA loans originated in California increased from 15.11 percent in FY 2010 to 18.90 percent in FY 2012, likely due to the decrease in average house prices in most parts of California and the increase of FHA loan size limit which resulted in more mortgages being able to qualify for FHA loan size limit. Currently, loans in California comprise the largest percentage of all FHA loans in dollar volume.

Historical house prices in the local housing markets are captured by our econometric models through the variables measuring recent local and national home price appreciation, current loan-

to-value ratios, and the dispersion of house price growth rates within a location. The geographic concentration of the Fund and projected values of these variables in the various locations have been reflected in the actuarial simulation model.

C. Originations by Mortgage Type

Exhibit IV-4 shows that the fully underwritten 30-year fixed-rate mortgage (FRM) has comprised the majority of FHA's single-family business, representing an average share of approximately 72.15 percent of the business over the period 1985-2014. The share of total mortgages represented by 30-year FRMs began to change in the early 1990s when FHA started insuring the adjustable-rate mortgage (ARM) and the streamline-refinancing mortgage (SR). For the next few years, ARM and SR mortgages gradually assumed a bigger share of annual loan originations and the 30-year FRM share decreased. FY 1993, FY 1994, and FY 2003 recorded the lowest shares of 30-year FRMs. An opposite trend has emerged from FY 2003 through FY 2007, in which 30-year FRM endorsements increased from 51.42 percent to 92.14 percent, while 30-year SR endorsements dropped from 36.95 percent to 5.12 percent. However, the share of 30-year FRMs endorsed in FY 2009 through FY 2013 dropped to an average level of 71.24 percent. For FY 2014 the volume of 30-year FRM increased back to 81.53 percent.

The ARM share of the portfolio, including streamline refinance ARMs, shrank dramatically from 11.52 percent in FY 2005 to 1.05 percent in FY 2009. It subsequently rose to 6.03 percent in FY 2011, declined again to 0.95 percent in FY 2013, and rose to 3.74 percent in FY 2014. The decline in the ARM share is likely a result of borrowers trying to lock into the recent record low mortgage rates, and the increase is result from the expectation that lower mortgage rates will continue. The 15-year FRMs have increased from 1.22 percent in FY 2007 to 6.34 percent in FY2012 but have declined in the last two years and are at 2.68 percent in FY 2014. The 15-year SR continues to be a relatively minor product type in the Fund.

The impacts of the dynamics of the concentrations of product types on the economic value of the Fund are captured by our econometric models, which are estimated separately for each of the six individual mortgage product types.

Exhibit IV-4: Percentage of Origination Volume by Mortgage Type

Fiscal Year	Fully Underwritten Mortgages			Streamline Refinancing		
	30-Year FRMs	15-Year FRMs	ARMs	30-Year SRs	15-Year SRs	ARMs SRs
1985	92.00	7.75	0.14	0.08	0.03	0.00
1986	88.93	8.07	0.74	1.90	0.36	0.00
1987	80.44	4.97	1.47	11.22	1.84	0.06
1988	86.30	3.59	4.98	4.64	0.45	0.04
1989	92.95	2.69	1.52	2.64	0.19	0.00
1990	93.09	2.77	0.80	3.09	0.25	0.00
1991	88.20	3.14	4.43	3.63	0.57	0.04
1992	66.79	2.51	16.35	10.84	2.17	1.34
1993	45.78	2.25	12.14	29.96	7.75	2.13
1994	42.49	1.81	16.97	27.95	8.06	2.72
1995	65.10	1.28	29.25	2.78	0.94	0.65
1996	61.09	1.29	25.42	8.65	1.72	1.83
1997	57.18	1.10	35.06	3.62	0.69	2.35
1998	65.56	1.16	11.93	17.78	1.39	2.18
1999	73.57	1.13	4.24	18.35	1.74	0.98
2000	85.36	0.71	11.04	2.06	0.26	0.57
2001	75.84	0.94	2.08	19.77	0.65	0.73
2002	66.96	1.21	6.05	21.11	1.57	3.09
2003	51.42	1.34	3.89	36.95	3.12	3.29
2004	63.62	1.36	8.70	19.53	2.43	4.36
2005	69.55	1.26	8.67	16.30	1.37	2.85
2006	88.66	1.35	2.65	6.66	0.48	0.21
2007	92.14	1.22	1.34	5.12	0.11	0.07
2008	90.78	1.59	1.54	5.80	0.14	0.15
2009	76.78	2.20	0.73	19.58	0.38	0.32
2010	78.70	3.63	2.86	13.43	0.36	1.03
2011	72.64	5.68	4.22	15.03	0.63	1.81
2012	65.05	6.34	1.40	25.08	1.17	0.96
2013	58.56	3.07	0.57	36.46	0.95	0.38
2014 ^a	81.53	2.68	3.00	11.60	0.44	0.74

Source: FHA data warehouse, June 30, 2014 extract.

^a Based on partial year data.

D. Initial Loan-to-Value Distributions

Based on previous econometric studies of mortgage behavior, a borrower's equity position in the mortgaged house is one of the most important drivers of default behavior. The larger the equity position a borrower has, the greater the incentive to avoid default on the loan. The original LTV is the complement of the borrower's equity at origination. Exhibit IV-5 shows the distribution of mortgage originations by original LTV categories for the period from FY 1985 through FY 2014.

As Exhibit IV-5 indicates, the distribution among original LTV categories shifted significantly after FY 1999. Over half of the loans insured during the period of FY 2000 to FY 2005 had LTVs greater than or equal to 97 percent. This concentration in the highest risk category gradually declined during the next four years. In 2008, HERA placed a limit of 96.5 percent on original LTV, with no additional allowance for the financing of closing costs. During FY 2009, 20.5 percent of mortgages had LTV ratios of 97 percent or more. This is a 63 percent reduction from the share in FY 2005, where over 55.52 percent of that book of business was concentrated in this highest LTV category. In FY 2010 through FY 2014, this concentration further dropped to only 4.49, 5.12, 4.29, 3.16 and 2.15 percent, respectively. Thus the percentage of mortgages in this highest original LTV category in FY 2014 was less than 5 percent of the corresponding percentage in FY 2005.

The original LTV concentration of individual books of business affects the econometric models in two ways. First, it serves as the starting position for updating the current LTV variable. Holding everything else constant, loans with higher original LTVs will experience a higher current LTV in future years. Second, the original LTV itself is also included in the models to capture potential behavioral differences among borrowers who self-select into different original LTV categories. For a streamline refinance loan, we use the original LTV of the prior fully underwritten mortgage, updated for the local house price index and amortization, as a proxy for this variable.

Exhibit IV-5: Percentage of Origination Volume by Original LTV Category

Books of Business	Unknown LTV	≤ 80%	> 80% ≤ 90%	> 90% ≤ 95%	> 95% < 97%	≥ 97%
1985	1.11	16.19	31.22	27.14	21.69	2.64
1986	0.56	18.26	30.33	27.35	20.51	3.00
1987	0.18	15.57	27.26	29.84	24.02	3.13
1988	0.13	8.01	19.72	35.57	31.87	4.71
1989	8.90	6.79	16.86	33.13	29.89	4.43
1990	11.90	6.15	16.20	32.21	29.14	4.40
1991	1.79	5.59	15.74	29.70	30.07	17.11
1992	1.76	4.39	13.99	28.03	38.26	13.57
1993	0.31	3.65	12.85	25.76	32.72	24.73
1994	0.24	3.46	11.70	24.43	32.77	27.40
1995	0.07	2.75	10.36	24.46	34.31	28.05
1996	0.03	2.84	11.10	25.50	34.72	25.81
1997	0.01	3.26	11.43	26.18	34.67	24.45
1998	0.01	3.55	12.23	26.46	34.85	22.91
1999	0.00	3.17	9.10	13.29	30.59	43.84
2000	0.00	2.34	6.23	6.81	32.54	52.07
2001	0.00	3.27	7.56	6.85	25.32	57.00
2002	0.00	3.88	8.09	6.84	24.23	56.96
2003	0.00	5.47	9.61	7.11	24.18	53.63
2004	0.01	5.56	9.17	7.23	23.66	54.38
2005	0.01	5.80	9.22	6.81	22.65	55.52
2006	0.01	6.81	10.06	13.88	19.91	49.34
2007	0.01	7.34	11.46	20.91	18.04	42.24
2008	0.01	6.17	12.05	24.04	13.41	44.31
2009	0.01	5.35	14.10	19.62	40.40	20.52
2010	0.01	5.01	14.97	11.44	64.08	4.49
2011	0.01	5.08	14.58	11.23	63.99	5.12
2012	0.02	5.61	11.31	10.00	68.77	4.29
2013	0.01	4.73	10.66	9.68	71.76	3.16
2014 ^a	0.01	5.02	10.56	9.29	72.98	2.15

Source: FHA data warehouse, June 30, 2014 extract

^a Based on partial year data.

E. Borrower Credit History Distributions

Credit score data were collected through two different channels. The first channel includes credit scores collected for a sample of FHA applications from FY 1992, FY 1994, and FY 1996, and subsequently extended to loan applications during FY 1997 through FY 2004. This set of credit score data is particularly useful because these loans have existed for many years and provide valuable historical delinquency, claim and prepayment performance information. The limitation of this data source is that it covers only a limited sample of FHA loans. In addition, the sample was originally collected for policy research purposes and represents a choice-based sample. For example, there was over-sampling of early-default loans among applications over FY 1997 through FY 2004.

Since May 2004, all lenders originating loans for FHA insurance have been required to report borrower credit scores directly to HUD if any credit scores were ordered as part of the underwriting process. All loans going through the FHA TOTAL scorecard have credit scores obtained electronically by the affiliated automated underwriting systems. This is the second source of credit score data. As there are no exceptions to this requirement, the credit scores collected through this channel are considered to be comprehensive and unbiased. These loans have grown to be the dominant source of credit score information for our analysis.

Exhibit IV-6 shows the distributions of fully underwritten FHA mortgage loans by borrower credit score categories and origination years. The distribution among credit score categories remained stable for the FY 2005 through FY 2008 books. For loans originated after FY 2008, the credit score distribution showed significant improvement over the previous years. Approximately 45.61 percent of the FY 2014 loans have credit scores above 680. Loans with credit scores below 600 are only 1 percent of the loans originated in FY 2014, which is a substantial decline from the FY 2008 book, where 22.64 percent of the loans had credit scores below 600.

In the econometric models, we also controlled for missing and uncollected credit scores. In Exhibit IV-6, the category “Missing” refers to loans with insufficient borrower credit history to generate a credit score, and the category “Not Collected” refers to loans where no attempt was made to obtain the credit score for some of the FY 2004 and earlier loans.

Exhibit IV-6: Percentage of Origination Volume by Credit Score among Fully Underwritten Loans

Books of Business	Missing	300-499	500-559	560-599	600-639	640-679	680-850	Not Collected
1996 ^a	3.99	0.03	0.71	1.87	3.78	4.47	8.23	76.91
1997 ^a	2.45	0.19	1.39	2.54	4.15	3.95	5.60	79.73
1998 ^a	1.91	0.24	1.83	3.16	5.19	4.67	5.52	77.47
1999 ^a	1.81	0.22	1.82	3.29	5.37	4.64	4.99	77.86
2000 ^a	1.98	0.33	2.43	3.45	4.97	3.98	4.01	78.85
2001 ^a	1.46	0.27	2.12	3.29	4.61	3.76	3.92	80.58
2002 ^a	1.42	0.31	2.31	3.56	5.07	4.19	4.57	78.58
2003 ^a	1.56	0.32	2.68	4.26	6.14	5.15	5.63	74.27
2004 ^b	1.43	0.51	4.92	8.61	12.56	10.41	11.70	49.85
2005	5.04	0.93	9.32	16.94	24.55	20.24	22.98	
2006	4.76	0.91	8.68	16.53	24.36	20.68	24.08	
2007	4.59	1.43	11.62	19.39	24.78	18.79	19.40	
2008	2.35	0.80	7.10	14.74	24.62	22.39	27.99	
2009	1.00	0.05	1.20	5.60	19.34	25.32	47.50	
2010	0.96	0.01	0.19	1.04	14.32	26.61	56.86	
2011	0.72	0.00	0.08	0.59	10.02	29.06	59.52	
2012	0.39	0.00	0.11	0.62	9.53	32.30	57.04	
2013	0.27	0.00	0.10	0.50	7.28	37.63	54.23	
2014 ^c	0.22	0.00	0.10	0.90	10.93	42.25	45.61	

^a Credit score data are obtained from the previous FHA special data collection project. Early-default loans were over-sampled during the years 1997 to part of 2004.

^b Starting May 2004, lenders were required to report credit score data directly to FHA.

^c Based on partial year.

F. Initial Relative Loan Size Distributions

The relative loan size variable is computed by comparing the mortgage origination amount with the average loan size of all other FHA-insured loans originated within the same period and in the same state. Empirical results show that this variable is very significant in prepayment-related terminations.

FHA experience indicates that larger loans tend to perform better compared with smaller loans in the same geographical area, all else being equal. Larger loans incur claims at a lower rate and in those cases where a claim occurs, loss severity tends to be lower. Prior to the increase in FHA's

loan limits in FY 2008, houses securing larger FHA loans tended to fall into the average house price range within their surrounding areas. Since this market is relatively liquid and there are a relatively large number of similar-quality homes in the area, the house price volatility of these houses tends to be relatively smaller in comparison to the house price volatility of extremely low- and high-priced houses. With the increased FHA loan size limit, FHA endorsements during these past few years included higher-priced houses.

Exhibit IV-7 shows the percentage of new fully underwritten mortgage originations within each relative loan size category. The distribution has been reasonably stable over time with the largest share in the 75-to-125 percent of area average loan size categories. However, since FY 2000, there has been a trend of a steady increase in the dispersion among loan size categories. The proportion in the highest loan size category increased from 9.84 percent in FY 2008 to 12.94 percent in FY 2014. On the other hand, the share in lowest loan size category also increased from 6.96 percent in FY 2008 to 9.59 percent in FY 2014. The increase in both the highest and lowest loan size categories demonstrate the penetration of FHA products into high-balance loans and the resurgence of the low-balance loan.

Our econometric models account for the differences both in the propensity to default and in their loss severity.

Exhibit IV-7: Percentage of Origination Count by Relative Loan Size

Books of Business	0-50% of Average Loan Size	50-75% of Average Loan Size	75-100% of Average Loan Size	100-125% of Average Loan Size	125-150% of Average Loan Size	>150% of Average Loan Size
1983	3.98	16.21	29.42	31.23	15.39	3.77
1984	4.20	16.81	29.27	30.29	14.98	4.45
1985	4.16	16.60	29.02	30.44	15.96	3.83
1986	3.15	15.61	30.38	33.72	14.56	2.59
1987	2.92	16.06	30.42	33.24	14.85	2.49
1988	3.77	17.34	29.10	29.70	15.46	4.64
1989	4.22	17.69	28.82	29.38	14.35	5.54
1990	4.44	18.32	28.69	26.93	15.49	6.13
1991	4.54	18.27	28.70	26.59	15.52	6.38
1992	4.21	17.60	29.21	28.02	15.20	5.76
1993	3.69	17.41	29.91	28.75	15.53	4.72
1994	3.74	17.82	29.52	28.20	15.96	4.76
1995	3.99	18.43	28.85	27.52	15.84	5.38
1996	3.96	18.11	28.78	28.19	16.20	4.77
1997	4.05	18.12	28.62	28.22	16.07	4.92
1998	4.00	17.69	28.77	29.08	15.68	4.78
1999	4.44	18.36	29.03	27.26	14.84	6.07
2000	4.94	18.71	28.53	26.02	14.87	6.93
2001	4.98	18.37	28.85	26.27	14.63	6.89
2002	5.14	18.09	28.97	26.42	14.49	6.89
2003	4.97	17.86	28.84	27.26	14.63	6.43
2004	5.30	18.46	28.17	26.53	14.63	6.91
2005	5.31	19.11	27.78	26.06	14.64	7.09
2006	5.70	19.86	26.96	25.19	14.39	7.90
2007	6.15	20.07	26.43	24.58	14.21	8.55
2008	6.96	20.45	27.58	22.69	12.47	9.84
2009	8.84	21.67	26.17	19.70	11.37	12.27
2010	9.72	22.31	25.55	18.60	10.77	13.05
2011	10.95	22.67	24.29	17.68	10.47	13.94
2012	10.61	22.68	24.32	18.10	10.67	13.62
2013	10.13	22.22	24.99	18.48	10.74	13.43
2014 ^a	9.59	22.11	25.47	18.87	11.02	12.94

Source: FHA data warehouse, June 30, 2014 extract

^a Based on partial year data.

G. Initial Contract Interest Rate

Exhibit IV-8 shows the average mortgage contract rate by mortgage type since FY 1995. Average contract rates in FY 2013 are the lowest of this entire time period.

In general, an FRM with a lower initial contract rate tends to prepay at a slower speed. As interest rates are projected to rise in the next two years, the prepayment rates of the recent originations are likely to remain low. As these loans will have longer durations, as reflected in our econometric models, more insurance premium income will be generated, thus tending to improve the economic value of these recent books with historical low contract rates.

Also, a mortgage with a contract rate lower than the market rate tends to experience lower probability of default. This tendency is reflected in our econometric models. As mortgage rates rise in the future, the recent low-interest-rate books are projected to incur fewer defaults and claims, given the other factors affecting defaults and claims.

Exhibit IV-8: Average Contract Interest Rate by Loan Type (Percent)

Fiscal Year	30-Year FRMs	15-Year FRMs	ARMs	30-Year SRs	15-Year SRs	ARM SRs	Book of Business
1995	8.39	8.23	7.18	8.70	8.74	7.34	8.10
1996	7.84	7.53	6.49	8.01	7.69	6.79	7.53
1997	7.97	7.75	6.53	8.29	8.04	6.81	7.51
1998	7.37	7.18	6.12	7.58	7.18	6.48	7.25
1999	7.24	6.95	6.00	7.17	6.89	6.05	7.16
2000	8.30	8.07	6.95	8.31	8.05	6.19	8.16
2001	7.56	7.12	6.19	7.42	6.85	6.12	7.49
2002	7.00	6.53	5.28	6.95	6.42	5.31	6.84
2003	6.07	5.50	4.38	6.01	5.49	4.44	5.91
2004	6.12	5.57	4.46	5.98	5.52	4.39	5.88
2005	5.92	5.63	4.79	5.85	5.65	4.67	5.79
2006	6.33	6.18	5.42	6.14	6.04	5.13	6.28
2007	6.51	6.40	5.62	6.38	6.25	5.59	6.49
2008	6.33	5.95	5.40	6.08	5.63	5.33	6.29
2009	5.59	5.11	4.94	5.26	4.80	4.52	5.51
2010	5.13	4.62	3.97	5.12	4.65	4.26	5.07
2011	4.65	4.16	3.51	4.62	4.16	3.68	4.56
2012	3.97	3.46	3.13	3.97	3.53	3.37	3.92
2013	3.62	3.15	2.99	3.71	3.36	2.89	3.63
2014 ^a	4.35	3.75	3.32	4.54	3.88	3.38	4.32

Source: FHA data warehouse, June 30, 2014 extract.

^a Based on partial year data.

H. Source of Downpayment Assistance

Exhibit IV-9 reports the distribution of annual loan endorsements by source of downpayment assistance since FY 2002. Secondary loans provided by local governments were included in the category of downpayment assistance by government. Starting in FY 2002, there was a rapid increase in the share of loans with gift letters from non-profit, religious, or community institutions. This concentration increased dramatically to almost 25 percent in the FY 2005 to FY 2007 books of business. Following the passage of HERA, which effectively terminated seller-financed downpayment assistance effective October 1, 2008, the share of loans with this type of assistance declined to negligible amounts after FY 2008.

Exhibit IV-9: Percentage of Downpayment Assistance Loan Counts by Source^a

Origination Fiscal Year	No Gift	Relative	Non-profit, Religious, or Community	Government	Employer
2002	82.26	9.15	7.05	1.48	0.06
2003	81.35	7.41	9.76	1.42	0.06
2004	70.24	9.59	18.05	2.04	0.08
2005	63.87	9.50	23.52	3.03	0.08
2006	62.03	9.39	24.30	4.18	0.10
2007	65.58	7.80	23.14	3.40	0.08
2008	72.21	7.12	18.91	1.71	0.06
2009	85.27	11.55	2.52	0.59	0.07
2010	82.05	16.95	0.12	0.79	0.08
2011	83.48	15.17	0.17	1.11	0.07
2012	84.20	14.57	0.17	0.99	0.06
2013	86.16	12.69	0.11	0.97	0.06
2014 ^b	78.31	19.87	0.24	1.46	0.11

Source: FHA data warehouse, June 30, 2014 extract.

^a As a percentage of all Fund endorsed loans, including purchase and refinance loans. The rate of downpayment assistance would be much higher if refinance loans were excluded from this calculation.

^b Based on partial year data.

Exhibit IV-10 shows the cumulative claim rates realized since FY 2002 on loans by downpayment gift source and origination year. Loans with any form of downpayment assistance performed worse across all origination years than loans receiving no downpayment assistance. The discrepancy in claim rates disappeared after the seller financed down payment assistance was ruled out by HERA. In order to reflect this differential performance of loans with alternative downpayment assistance sources, our econometric models incorporated a series of

categorical variables to reflect this important characteristic. The estimated coefficients of these downpayment assistance-source variables are both economically and statistically significant.

Exhibit IV-10: Cumulative-to-Date Percentage Claim Rates by Downpayment Assistance Source

Origination Fiscal Year	No Gift	Relative	Non-profit, Religious, or Community	Government	Employer
2002	6.04	7.22	18.04	15.78	8.51
2003	6.31	8.63	20.66	17.34	11.80
2004	8.32	10.13	22.37	16.14	13.23
2005	11.87	13.81	25.81	19.84	17.54
2006	14.93	16.57	27.11	19.40	23.95
2007	16.66	17.20	28.07	21.10	20.39
2008	13.37	12.07	20.62	16.78	12.65
2009	7.03	5.78	14.75	8.77	7.84
2010	3.00	2.61	2.76	2.99	3.52
2011	1.22	0.97	1.00	1.12	0.70
2012	0.35	0.26	0.39	0.28	0.26
2013	0.06	0.03	0.00	0.02	0.00
2014 ^a	0.00	0.00	0.00	0.00	0.00

Source: FHA data warehouse, June 30, 2014 extract.

^a Based on partial year data.

Among the different downpayment assistance sources, loans with gifts from non-profit organizations have the highest cumulative claim rates for all origination years. GAO reported that the downpayment assistance loans had been misused by many non-profit organizations, with the assistance being funded by home sellers.⁴³ The high concentration of the FY 2004 to FY 2008 books in loans with downpayment assistance from non-profit organizations makes the claim risk of these books of business particularly high.

These loans have contributed significant negative economic value to the Fund in recent years, as shown by Exhibit IV-11, which reports the present value of the cash flows of these loans since their origination by downpayment assistance sources. While loans funded with assistance from non-profit organizations accounted for about 13.5 percent of the total origination volume of FY

⁴³ “Mortgage Finance Additional Action Needed to Manage Risks of FHA-Insured Loans with Downpayment Assistance,” Government Accountability Office, November 2005.

2001 through FY 2008, they generated 32.10 percent of the negative present value of the cash flows from these books of business.

Exhibit IV-11: Present Value of Cash Flows since Endorsement, by Downpayment Assistance Source as of the End of FY 2014 (\$Millions)^a

Origination Fiscal Year	No Gift	Relative	Non-profit, Religious, or Community	Government	Employer	Total
2001	-445	-133	-347	-74	0	-999
2002	-510	-93	-626	-91	0	-1320
2003	-605	-129	-843	-119	0	-1695
2004	-1738	-317	-1756	-225	0	-4037
2005	-2579	-576	-2609	-492	0	-6256
2006	-2963	-533	-2048	-600	0	-6144
2007	-4916	-582	-2662	-675	0	-8835
2008	-12463	-939	-4470	-689	0	-18562
2009	-9570	-432	-659	-325	0	-10986
2010	1282	407	-12	-165	0	1512
2011	5841	1116	7	206	0	7169
2012	9083	1709	12	422	0	11226
2013	11766	2243	12	565	0	14586
2014	8805	2427	-3	560	0	11788
Total	987	4169	-16004	-1705	0	-12553

^a Numbers may not add up due to rounding error.

These costly non-profit down payment assistance loans have a significant negative impact on the financial state of the Fund. Exhibit IV-11 shows that, since their initial endorsement through the eventual termination, these loans contribute *negative* \$16.00 billion to the economic value of the MMI Fund as of the end of FY 2014.

We estimated that these loans accounted for \$26.29 billion of the amortized IIF as of the end of FY 2014. Therefore, if these loans had been excluded from the Fund, the revised economic value and the amortized IIF of the Fund would have been \$21.94 billion and \$1033.63 billion, respectively. On the positive side, following the elimination of this type of high-risk loan by HERA in 2008, the performance of recent and future books of business are improved over what would have been the case if these loans had still been underwritten in significant amounts.

Section V: Fund Performance under Alternative Scenarios

The realized economic value of the Fund will vary from the Review's estimate if the actual drivers of loan performance deviate from the baseline projections. In this section, we present the baseline economic value from the Monte Carlo simulation and two alternative scenarios. The base case of the Review is the mean of the economic values of the Fund from the 100 simulated paths. Each alternative scenario estimates the performance of the Fund using the future interest and house price appreciation rates simulated as deterministic path.

The first five alternative economic scenarios were selected from our 100 simulated paths; in particular, the paths that yielded the 10th best, 25th best, 25th worst, 10th worst and the worst projected economic values. The sixth alternative path is the most stressful scenario among Moody's Analytics alternative forecasts published in July 2014. The last path is the Moody's baseline forecast as a deterministic path. The seven alternative scenarios are

- 10th Best Path in Simulation, the path that resulted in the 10th highest economic value in the Monte Carlo simulation.
- 25th Best Path in Simulation, the path that resulted in the 25th highest economic value in the Monte Carlo simulation.
- 25th Worst Path in Simulation, the path that resulted in the 25th lowest economic value in the Monte Carlo simulation.
- 10th Worst Path in Simulation, the path that resulted in the 10th lowest economic value in the Monte Carlo simulation.
- The Worst Path in Simulation, the path that resulted in the lowest economic value in the Monte Carlo simulation.
- Moody's Protracted Slump Scenario, the most stressful alternative scenario forecasted by Moody's Analytics in July 2014.
- Moody's July 2014 baseline forecast as a deterministic scenario

The values of the projected house price indices and interest rates for individual scenarios are described in Appendix D.

Exhibit V-1 reproduces the baseline projected Fund performance under the average of our Monte Carlo simulation paths as shown in Exhibit II-1. The estimated economic value of the Fund as of the end of FY 2014 is positive \$5.93 billion, and the projected economic value for FY 2021 is positive \$80.54 billion. These projections constitute the baseline, against which the projections from the alternative scenarios are to be compared. The economic values and IIFs of the Fund for FY 2014 through FY 2021 under the seven alternative scenarios are presented in Exhibits V-2 to V-8. While the baseline projection is based on a stochastic Monte Carlo simulation, each of the

alternative scenarios is based on a single specified path of HPI, unemployment and interest rates. We discuss the results of these alternative simulations in order.

Exhibit V-1: Projected Baseline Fund Performance (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	5,932	1,154,818	1,059,925	11,788	134,000	
2015	16,161	1,158,756	1,049,949	10,213	124,505	17
2016	24,201	1,184,196	1,060,024	7,851	113,488	189
2017	33,022	1,220,041	1,079,960	8,275	119,065	547
2018	43,780	1,264,146	1,107,688	9,712	136,883	1,046
2019	55,330	1,311,234	1,137,046	9,856	141,338	1,695
2020	67,349	1,362,153	1,168,977	9,747	147,547	2,272
2021	80,541	1,420,350	1,207,055	10,364	159,462	2,828

A. Selected Scenarios from Monte Carlo Simulation

The Monte Carlo simulation approach provided additional information about the probability distribution of the economic value of the MMI Fund (excluding HECMs) with respect to different possible future economic conditions and the corresponding prepayments, claims and loss rates. In addition to the estimation of the expected economic value of MMI Fund, the simulation also provided the economic values associated with each one of the 100 possible future economic paths. The distribution of economic values based on these scenarios allows us to gain insights into the sensitivity of the Fund's economic value to different economic conditions.

Exhibits V-2 to V-6 report the projection of the economic value of the Fund under the five alternative future economic conditions from the 100 simulated paths. Exhibit V-2 is based on the path that produces the 10th best result for the FY 2014 economic value. This scenario results in the highest economic value among alternative paths presented in this section from FY 2014 to FY 2021. Under this path, the economic value of the Fund is \$14.58 billion at the end of FY 2014. This is \$8.65 billion better than that of the mean across the 100 paths. The high economic value in this path resulted from a rapid increase in the mortgage rate after FY 2016, and higher house price appreciation rate during the near future years. This creates high insurance premium cash inflow and low claim loss cash outflow in the near future. There is approximately a 10 percent chance the FY 2014 economic value of the Fund can be higher than \$14.58 billion.

Exhibit V-2: Fund Performance: 10th Best Simulation Path (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	14,581	1,150,449	1,055,534	14,494	134,000	
2015	28,518	1,154,498	1,045,753	13,896	128,454	41
2016	38,867	1,172,960	1,050,316	10,015	107,608	333
2017	44,940	1,210,834	1,072,630	5,196	106,562	878
2018	50,876	1,244,321	1,092,926	4,512	116,096	1,423
2019	57,977	1,296,838	1,137,214	5,132	125,184	1,969
2020	64,432	1,330,000	1,152,138	4,073	128,069	2,381
2021	66,427	1,382,085	1,184,347	-710	122,381	2,705

Exhibit V-3 demonstrates that under the 25th best simulation path, the economic value of the fund at the end of FY 2014 would be \$10.87 billion, which is \$4.94 billion better than the baseline. The FY 2021 economic value would be \$81.46 billion, which is \$0.92 billion better than the baseline. This path features higher home price appreciation before 2020, and a moderate interest rate level throughout the forecast period.

Exhibit V-3: Fund Performance: 25th Best Simulation Path (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	10,873	1,153,816	1,058,671	12,951	134,000	
2015	22,522	1,155,134	1,045,940	11,618	123,329	30
2016	30,657	1,162,582	1,040,454	7,872	110,968	263
2017	39,532	1,179,713	1,044,961	8,183	114,838	692
2018	48,737	1,199,878	1,052,769	7,953	120,489	1,252
2019	59,310	1,230,223	1,067,427	8,687	124,604	1,887
2020	70,046	1,289,450	1,111,650	8,301	125,538	2,436
2021	81,461	1,353,796	1,162,322	8,473	122,482	2,941

Exhibit V-4 shows that the FY2014 economic value under the 25th worst simulation path would be \$2.28 billion. However, the FY 2021 economic value would be positive \$85.16 billion, higher than that of the 25th best simulation path. The FY2014 economic value is \$3.66 billion below the baseline and the FY2021 economic value is \$4.61 billion above the baseline, respectively. This path is characterized by extremely low interest rate level before FY 2018 and below-baseline house price index after FY 2018.

Exhibit V-4: Fund Performance: 25th Worst Simulation Path (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	2,277	1,164,033	1,068,342	11,758	134,000	
2015	17,971	1,179,682	1,068,035	15,687	157,102	6
2016	29,391	1,209,360	1,080,673	11,210	113,214	210
2017	41,763	1,244,981	1,098,466	11,708	115,613	664
2018	52,187	1,287,165	1,120,927	9,102	112,776	1,322
2019	64,088	1,327,739	1,141,181	9,881	118,689	2,020
2020	76,507	1,363,220	1,155,687	9,786	130,099	2,632
2021	85,155	1,408,380	1,181,077	5,436	120,959	3,212

Exhibit V-5 shows the 10th worst result of FY 2014 economic value among the 100 simulated paths. Under this more pessimistic path, the economic value of the Fund is *negative* \$3.04 billion at the end of FY 2014, which is \$8.97 billion worse than the baseline expected economic value. This path features long-term depressed interest rate environment before FY 2022, which reduces revenue, and increases default rate. There is approximately a 10 percent probability that the realized economic value to be even more stressful than this path, and result in even lower economic value.

Exhibit V-5: Fund Performance: 10th Worst Simulation Path (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	-3,040	1,167,061	1,071,191	9,681	134,000	
2015	6,071	1,159,588	1,051,238	9,119	119,125	-9
2016	14,739	1,150,207	1,031,315	8,597	122,733	71
2017	25,666	1,164,246	1,034,003	10,594	131,951	333
2018	38,715	1,199,077	1,055,179	12,237	145,335	813
2019	49,857	1,238,049	1,079,482	9,643	128,626	1,499
2020	68,994	1,298,147	1,122,566	17,090	192,570	2,048
2021	96,905	1,370,104	1,173,607	25,014	240,668	2,897

Exhibit V-6 shows the worst result from our Monte Carlo simulation. Under this scenario, the economic value of the Fund can be *negative* \$31.43 billion. This is a depression-level scenario, where house prices drop rapidly by 12 percent from FY 2015 through FY 2018, and house prices would stay stagnant till FY 2022.

Exhibit V-6: Fund Performance: Worst Simulation Path (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	-31,430	1,119,680	1,026,719	8,048	134,000	
2015	-26,119	1,135,454	1,028,826	5,400	116,597	-88
2016	-23,989	1,148,378	1,029,131	2,435	98,107	-305
2017	-21,082	1,151,112	1,025,994	3,448	85,912	-542
2018	-17,897	1,195,053	1,068,908	3,852	81,875	-668
2019	-13,946	1,229,183	1,094,561	4,644	83,335	-693
2020	-7,481	1,279,955	1,137,760	7,038	106,985	-573
2021	-411	1,365,266	1,208,722	7,384	102,069	-314

B. Moody's Protracted Slump Scenario

Exhibit V-7 present the estimated economic value of the Fund based on Moody's "protracted slump" economic scenario. Under Moody's protracted slump scenario, the level of the house price index converges to the long-term index level of its baseline forecast. As a result, this scenario shows low house price growth rates in the short-term, followed by higher growth rates. We applied the same adjustment we applied last year, where the growth rates of this scenario converge to the long-run growth rates of Moody's baseline scenario, instead of the indices themselves converging to their long-term levels. This adjustment avoids having the stress scenarios show exuberant growth after the initial stress period. As a result, the protracted slump scenario analyzed in this Review is more stressful than the original Moody's scenario.

Exhibit V-7 shows that the FY 2014 economic value would be *negative* \$40.01 billion under this most pessimistic alternative scenario published by Moody's in July 2014, which is \$45.94 billion lower than the stochastic baseline. This value is even lower than that from the worst path in our Monte Carlo simulation. Under this scenario, the FY 2021 economic value would be \$11.33 billion which is \$69.21 billion lower than the stochastic baseline.

Exhibit V-7: Fund Performance: Protracted Slump (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	-40,010	1,185,469	1,088,215	6,994	134,000	
2015	-32,155	1,205,699	1,089,650	7,967	94,831	-112
2016	-25,390	1,190,795	1,058,633	7,141	80,099	-376
2017	-18,998	1,187,663	1,039,171	6,966	77,667	-573
2018	-12,598	1,204,213	1,038,178	7,002	83,690	-602
2019	-5,840	1,237,283	1,051,690	7,245	93,039	-488
2020	2,119	1,280,453	1,074,279	8,199	104,900	-240
2021	11,329	1,330,636	1,103,141	9,121	116,537	89

C. Moody's July 2014 Forecast as a Deterministic Scenario

Exhibit V-8 present the estimated economic value of the Fund based on Moody's baseline forecast as a deterministic scenario. The FY 2014 economic value is \$10.08 billion, which is 4.14 billion higher than the mean economic value from the Monte Carlo simulation. The FY

2021 economic value would be \$89.89 billion, which is \$9.35 billion higher than the baseline Monte Carlo.

Exhibit V–8: Fund Performance: Moody’s Baseline Forecast (\$ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorsements	Investment Earnings on Fund Balances
2014	10,075	1,156,855	1,061,850	13,103	134,000	
2015	21,448	1,161,406	1,052,128	11,345	118,780	28
2016	30,405	1,190,286	1,065,113	8,707	109,359	251
2017	39,849	1,229,176	1,087,286	8,757	110,609	687
2018	50,862	1,273,075	1,113,731	9,751	119,183	1,262
2019	62,830	1,319,558	1,141,463	9,999	123,536	1,969
2020	75,797	1,368,471	1,170,539	10,387	128,039	2,580
2021	89,893	1,421,294	1,202,497	10,913	133,538	3,182

D. Summary

Exhibit V-9 shows the Fund’s projected economic values from the baseline Monte Carlo simulation and those of the seven alternative single-path scenarios: the 10th best path in the simulation, the 25th best path, the 25th worst path, the 10th worst path, the worst path, Moody’s protracted slump scenario, and Moody’s baseline forecast as a deterministic scenario.

From the 25th best and worst paths, the Fund’s FY 2014 economic value has approximately a 50 percent probability of being in the range of \$2.28 billion to \$10.87 billion. From the 10th best and worst paths, the Monte Carlo simulation results indicate that there is an 80 percent chance that the economic value of the Fund would be between *negative* \$3.04 billion and positive \$14.58 billion. Further, among the 100 simulated paths, there are 16 paths that yield negative economic value as of the end of FY 2014. As a result, we conclude that there is approximately a 16 percent chance that the FY 2014 economic value of the Fund is negative.

Exhibit V-9: Projected Fund Economic Values by Alternative Scenarios (\$ Millions)

Fiscal Year	Baseline Monte Carlo	10th Best Path	25th Best Path	25th Worst Path	10th Worst Path	Worst Path	Moody's Protracted Slump	Moody's Baseline
2014	5,932	14,581	10,873	2,277	-3,040	-31,430	-40,010	10,075
2015	16,161	28,518	22,522	17,971	6,071	-26,119	-32,155	21,448
2016	24,201	38,867	30,657	29,391	14,739	-23,989	-25,390	30,405
2017	33,022	44,940	39,532	41,763	25,666	-21,082	-18,998	39,849
2018	43,780	50,876	48,737	52,187	38,715	-17,897	-12,598	50,862
2019	55,330	57,977	59,310	64,088	49,857	-13,946	-5,840	62,830
2020	67,349	64,432	70,046	76,507	68,994	-7,481	2,119	75,797
2021	80,541	66,427	81,461	85,155	96,905	-411	11,329	89,893

Section VI: Summary of Methodology

This section provides an overview of the analytical approach used in this Review. Appendix A provides an expanded explanation of the status transition models, as well as a description of the variables used in those models and how the loan status transition events were constructed. Appendices B, C, and D provide details on the cash flow model and the scenarios for sensitivity analyses. Appendix E describes the loss severity rate model, Appendix F the volume forecast model and Appendix G the equations used to model and project the economic variables in the Monte Carlo simulation.

A. Specification of FHA Mortgage Status Transition and Termination Models

This Review applies statistical techniques consistent with the literature and applicable to the FHA experience. The purpose of the analysis is to estimate the future incidences of claim and prepayment terminations for FHA forward loans in the mutual mortgage insurance portfolio, in order to project future outstanding balances, cash flows, and economic values.

The statistical analysis is complicated by the fact that mortgage borrowers possess two mutually exclusive options, one to prepay the loan and the other to default by permanently ceasing payment. From FHA's point of view, prepayment and claim events are the corresponding outcomes of "competing risks" in the sense that they are mutually exclusive, and realization of one of these events precludes the other. Prepayment means cessation of cash flows from mortgage insurance premiums, but at the same time eliminating any chance of incurring claim losses. Conversely, termination through foreclosure or loss-mitigation techniques means claim costs are incurred, but uncertainty about the possibility and timing of prepayment is eliminated.

The models implemented for this Review extend beyond the prepay-claim competing risk framework. The major new transition stage since the 2009 Actuarial Review is the transition from current to 90-days or more delinquent, which we call default. Since the 2012 Review, cures from default were separated into cures by modification and cures by no or light modification. Since the 2013 Review, we also model the post-cure behavior of modified loans and self-cured loans separately with modification-related variables, namely a modification flag and the payment reduction ratio.

Another major enhancement introduced since the 2013 Review to model "blemished" current loans is the treatment of post-default status. Instead of simply marking a previously defaulted loan with a "prior_default" flag, we used the duration of post-default time to capture the decaying effect of a prior default.

Following the same procedure as last year, we separated out the transition from current to prepayment that is recaptured into FHA endorsements via streamline refinancing. This transition is used for estimating the origination volume of streamline refinance loans in future books. By making streamline refinancing endogenous, we more accurately capture the future profit and losses of those loans after the current loan is prepaid by the subsequent streamline refinance mortgage.

There are now five possible transitions from a loan in current status: remain current, become blemished current, default (enter 90+ days delinquent), prepay by streamline refinancing and prepay by a standard refinancing. Given that these are mutually exclusive and exhaustive outcomes, the sum of the probabilities for all five transitions is unity. Thus, only four transition equations need to be estimated and the fifth thereby inferred.

For a loan in default status at the beginning of a particular time period, it may prepay (streamline refinance is not allowed if delinquent), be claimed, be cured, or remain in default. As we did last year, cures are separated into two types: cures by modification and self-cures.

As a result, instead of estimating the probabilities of two termination events in the original Calhoun and Deng (2002) model, four probabilities of transition are estimated conditional on whether a loan is in current or default status.

Following the approach developed by Begg and Gray (1984), we estimated separate conditional binomial logistic models for each transition out of the current or default statuses and then mathematically recombined the parameter estimates to compute the corresponding multinomial logistic probabilities for the various competing risks of default, cure, claim, and prepayment.

The multinomial logistic models have several benefits over traditional linear regression. First, they ensure that the event probabilities sum to unity. This means that at any point in time, a loan must experience only one of the five possible transitions over the next period. Second, the possible values of each probability are constrained to be between zero and one. Third, as the probability of one transition type increases, the probabilities of the others are automatically reduced, reflecting the competing-risk nature among the transition events. Finally, they allow the conditional termination rates using loan-level data to be estimated. With loan-level observations, the possible outcomes at each point in time are either 0, the event did not happen, or 1, the event happened. Standard multivariate linear regression analysis is unsuitable for estimating discrete dependent variable models, whereas logistic models are specifically designed to handle these types of observations.

We applied a series of piece-wise linear spline functions to model the impact of some continuous variables, including mortgage age, current LTV, payment-to-income ratio, spread at origination, short-term home price appreciation, relative loan size, refinance incentive and borrower credit

scores. An important benefit of the spline specification over a categorical variable approach is that it allows changing marginal effects over the range of values of the variable while avoiding sudden jumps. For qualitative or categorical variables, such as season, judicial states and number of units, we necessarily adopted the dummy variable specification.

Following last year's approach the post-default time variable while in current status, default duration takes the form of a linear spline specification instead of using categorical variables. Due to the enhancement we made to the Monte Carlo simulation framework, we are now able to handle path-dependent variables more efficiently, and achieve more accurate results. See Appendix G for the details.

B. Loan Event Data

We used loan-level data to reconstruct quarterly loan-event histories by relating mortgage origination information to contemporaneous values of time-dependent factors. In the process of creating quarterly event histories, each loan contributed an observed "transition" for every quarter from origination up to and including the period of mortgage termination, or until the second quarter of FY 2014 if the loan remained active. The term "transition" is used here to refer to what happens to the loan from the start of one quarter to the start of the next quarter.

The FHA single-family data warehouse records each loan for which insurance has been endorsed and includes additional data fields updating the timing of termination by claim or prepayment. The data warehouse also maintains a record of loans entering and exiting default status. See Appendix A for the details of classifying mortgages over time according to their default status.

C. Estimation Sample

The entire population of loan-level data from the FHA single-family data warehouse was extracted for the FY 2014 analysis. This produced a population of over 29 million single-family loans originated between FY 1975 through the second quarter of FY 2014. Among these loans, historical status transition records during FY 1996 and later years were available and were used to estimate the loan status transition models. Our model estimation dataset did not include pre-1996 data due to the limited availability of reliable 90-day default episode data and a major change in FHA underwriting policies in FY 1996. The resulting dataset was used to generate loan-level transition event histories until the end of the observed data period.

Estimation and forecasting were completed for each of the following six FHA mortgage product types:

Product 1	FRM30	Fixed-rate 30-year fully underwritten purchase and refinance
Product 2	FRM15	Fixed-rate 15-year fully underwritten purchase and refinance
Product 3	ARM	Adjustable-rate fully underwritten purchase and refinance
Product 4	FRM30_SR	Fixed-rate 30-year streamlined refinance
Product 5	FRM15_SR	Fixed-rate 15-year streamlined refinance
Product 6	ARM_SR	Adjustable-rate streamlined refinance

In all, there are 8 transition equations to estimate for each of the 6 loan product types, for a total of 48 equations. Appendix A provides additional details on each of the transition types and reports the estimated coefficients for the transition probabilities.

We applied choice-based sampling to improve model estimation efficiency. Appendix A describes the theoretical background and technical details. Based on the absolute number of observations by loan type, the following sampling rates were used which varied by product to produce the estimation dataset:

Exhibit VI-1: Sampling Scheme on Various Product Types

Product Number	Product Type	Sampling Scheme
Product 1	FRM30	1) Clean periods of clean loans ⁴⁴ : 1% 2) Clean periods of non-clean loan ⁴⁵ : 10% 3) Non-clean periods of non-clean loan ⁴⁶ : 100%
Product 2	FRM15	100% for all loans
Product 3	ARM	100% for all loans
Product 4	FRM30_SR	1) Clean periods of clean loans: 6.25% 2) Clean periods of non-clean loan: 25% 3) Non-clean periods of non-clean loan: 100%
Product 5	FRM15_SR	100% for all loans
Product 6	ARM_SR	100% for all loans

⁴⁴“Clean Loans” means loans which have never defaulted, prepaid, claimed or cured throughout the entire history or up to the most current time.

⁴⁵“Clean periods of non-clean loan” means the periods before a loan first becomes default, prepay, claim or cured during the life of the loan.

⁴⁶“Non-clean periods of non-clean loan” means the periods after a loan first becomes default, prepay, claim or cured during the life of the loan.

D. Cash Flow Model

After we projected the future default, claim and prepayment rates using the econometric models, we then used this information to project the corresponding cash flows. The cash-flow model includes the calculation of five types of cash flows: (1) upfront mortgage insurance premiums, (2) annual mortgage insurance premiums, (3) net claim losses, (4) loss-mitigation-related expenses and (5) premium refunds. Two other cash flows were modeled in some previous Reviews, but are not expected to occur in the future. The administrative expense was discontinued according to Federal credit reform requirements, and distributive shares were suspended in 1990. There is no indication that either of these will be resumed in the foreseeable future. The Federal credit subsidy present value conversion factors published by the Office of Management and Budget are used in discounting future cash flows to determine their present value as of the end of FY 2014.

Since the 2013 Review, we also implemented a foreclosure backlog adjustment to estimate the processing of the accumulation of loans whose processing after foreclosure had been delayed due to lenders' concerns about applying proper foreclosure procedures. The purpose of this adjustment is to simulate the processing of 20,950 loans (versus 19,861 loans in Actuarial Review 2013) on the books at the end of the observation period, that had already held a foreclosure auction prior to January 31, 2013, or completed the foreclosure prior to July 31, 2013, but had not yet been claimed by July 31, 2014. State-level econometric analyses were performed to estimate the conditional termination speed. The corresponding cumulative probability function was used to simulate the timing of the claims of this extra foreclosure inventory; Appendix B provides the technical details.

HUD organized two note sale auctions in June and September of 2014. From the loan-level data provided by HUD, we terminated 37,523 loans from FY 2014Q1 to FY 2015Q1 and assigned observed and historical average loss rates for these loans. The adjustment improved the accuracy of the composition of the existing portfolio entering the simulation model.

E. Loss Severity Rate Model

FHA incurs a loss from a mortgage claim event. This loss amount is depends on many factors. The loss severity rate, defined as the loss amount divided by the unpaid principal balance of a loan at the time of claim is highly dependent on the disposition channel. In practice, foreclosed (FC) properties generally have higher severity compared to pre-foreclosure-sales (PFS). FC loans can be further segregated into real-estate-owned (REO) and third party sales (TPS). We developed three sub-models: an FC/PFS selection model, which predicts the probability a claim will be disposed as FC or PFS, and separate loss severity rate models for REO and PFS properties. Based on the current level of the TPS share of total FC loans and the long-term TPS

trend from Fannie Mae and Freddie Mac that have actively engaged in TPS program for relatively longer periods, we derived assumptions for the TPS ratio and TPS loss rates. The effective loss rate is the weighted average of the three separate loss severity rates. The loss severity models captures characteristics of the loan, the collateral, the borrower, and the housing market environment when a claim occurs. The FC/PFS selection model was estimated using logistic regression, while ordinary least square regressions were applied for the two loss severity rate models. Details of these models are provided in Appendix E.

F. Volume Forecast Model

We also enhanced the FHA mortgage volume model in order to better project future FHA loan origination volumes. The modeling approach first predicts the national purchase mortgage market volume and the national refinance market volume. Then the third equation projects FHA's fully underwritten refinance share of the national refinance volume. This share is applied to the national refinance volume to project the dollar volume of FHA's fully underwritten refinances. Similarly, FHA's purchase origination volume is calculated from FHA's purchase share of the national purchase volume and the estimated national purchase mortgage volume. Following the FY2013 Review, we have made some enhancements in the volume forecast model, by including an HPI variable. Also we have included the FHA refinance spread in the FHA refinance share model. Appendix F provides the technical details.

The prediction volumes vary according to alternative scenarios for interest rates and home prices in our Monte Carlo simulations. For example, a forecast of higher interest rates would depress refinancing volume. This year, FHA's streamline refinance volume and loan characteristics are endogenously generated from the current-to-streamline refinance transition equation. With this enhancement, the future streamline origination volume and compositions are now fully consistent with the projection of loans in the existing portfolio terminated through streamline refinances.

G. Monte Carlo Simulation

In the 2012 Review, for the first time we estimated the economic value of the Fund using a stochastic, Monte Carlo approach. In the 2011 and prior Reviews we calculated the present value (PV) of future cash flows based on a single, deterministic path. The Monte Carlo approach uses multiple paths, where a "path" is a set of economic variables whose values are projected out into the future. The set of economic variables that "drive" our behavioral equations—that is, they are critical explanatory variables in our transition, loss severity and volume models—are as follows:

- 1-year Treasury rates,

- 10-year Treasury rates,
- 30-year fixed rate mortgage (FRM) rates,
- FHFA national purchase-only house price index (HPI) and
- Unemployment rates.

We used the Moody's July 2014 baseline forecast as the median path for the simulations. We then constructed the random paths by applying historical dispersion behavior from the mean to the Moody's baseline forecast. The degree of dispersion is determined by the variances we estimated for the models for each of these risk drivers. The result is a collection of paths that are denser close to the median path and less dense further away from the median path. The models described in Appendix G explain how we generated these multiple random paths.

Each of the paths is equally likely to occur. Once the PVs are computed for each path they are averaged to compute the economic value of the future cash flows. In the literature, this approach is considered the preferred way to compute present values under uncertainty about future paths of the critical driver variables. In particular, this approach accounts for nonlinearities in the way the present values respond to alternative paths.

Using a stochastic approach requires a great deal of computational power, with the computational time increasing roughly proportional to the number of paths. We used 100 simulated paths to estimate the economic value of the future cash flows.

In 2013, one enhancement to the Monte Carlo simulation framework was to use dynamic simulation, or simulated incidence. In the 2012 simulation framework, we captured the randomness from the macroeconomic drivers and carried forward the calculated transition probabilities. When these probabilities depend on the history of the loan they are said to be path dependent. This caused the calculations of the economic value to become very computationally burdensome. This is because the state space grows very quickly requiring large amounts of computer memory. Dynamic simulation provides a method of reducing the memory requirement. Under this approach we used a sequence of random numbers to directly simulate the future evolution of a loan and hence explicitly incorporate the loan's previous path history into the simulation. Because we do not need to carry the past history and enumerate all the previous possible transitions, the dynamic simulation is much more efficient in computation memory and time, and this technique allows us to utilize more path-dependent variables in the model estimation, which had been infeasible in the past.

Another major simulation enhancement we introduced in the 2013 Review is the adoption of the antithetic variates method. Dynamic simulation can greatly increase simulation flexibility, but it can still be subject to material residual estimation error from a static simulation unless we use a very large number of simulation runs. Antithetic variates can be used to significantly reduce the simulation standard error and thus improve the convergence of the result. Thus by combining

these two enhancements, we are able to simultaneously improve simulation flexibility and accuracy.

This year, we implemented a full dynamic simulation process to capture the life cycle of streamline refinance loans. In this algorithm, we generate all the future streamline refinance originations from the simulated SR outcome from all previous vintages, both historical books and future books before the specific origination year. In this way we can accurately capture not only the previous vintage of the newly originated streamline refinance loans, but also their characteristics. Further, we can calculate the mortgage insurance premium (MIP) for streamline loans more accurately, at the loan level, instead of at the cohort level utilized in previous Actuarial Reviews.

Simulated random drivers of fundamental economic variables, combined with the detailed transition model, and the enhanced Monte Carlo simulation framework, has improved the performance and efficiency of this year's model. Further details of the simulation enhancements can be found in Appendix G.

Section VII: Qualifications and Limitations

The actuarial models used in this analysis are based on a theoretical framework and certain assumptions. This framework relates the rates of default, claim, loss and prepayment to a number of individual loan characteristics and certain key macroeconomic variables. The models are calibrated using advanced econometric regression techniques based on data from actual historical experience regarding the performance of FHA-insured mortgage loans. The parameters of the econometric models are estimated over a wide variety of loans originated since 1996 and their performance under the range of economic conditions and mortgage market environments experienced during the past 18 years. The estimated models are used together with assumptions about future loan portfolios and certain key economic assumptions to produce future projections of the performance of the Fund.

The financial estimates presented in this Review require projections of events up to 37 years into the future. These projections are dependent upon the validity and robustness of the underlying models and the assumptions about future economic environments and loan characteristics. These assumptions include economic forecasts by stochastic simulation models and Moody's Economy.com, and assumptions concerning the composition of FHA's future endorsement portfolio supplied by HUD. To the extent that the realized experience deviates from these or other assumptions, the actual results may differ, perhaps significantly, from current projections.

As of this writing, the U.S. housing and mortgage markets were recovering from the most stressful economic conditions since the Great Depression. During the 2006-2011 period, most housing markets in the country experienced a severe house price decline. Such extreme conditions have occurred in the last 30 years, but were restricted to certain regions of the country, such as Texas in the mid-1980s, New England in the late 1980s, or California in the early 1990s. It is necessary to go back to the Great Depression to find a housing recession of the magnitude and scale that has been recently experienced. The model used in this Review takes the future projected house price growth rates into account when computing default, claim, loss and prepayment rates.

A. Model Sensitivity to Economic Projections

The main purpose of this Review is to assess the long-term financial performance of the Fund. Two of the critical economic variables used in making these projections are future house prices and future interest rates. This year we have developed stochastic models to project the future distribution of house prices and interest rates using Monte Carlo simulation. Our stochastic models have been calibrated so that they are centered on Moody's July 2014 base-case economic forecasts. Hence the estimated results captured the impact of future deviations from Moody's base-case projections.

Our estimate of the Fund's economic value depends on our projected distribution of house prices and interest rates. This dependence is captured mostly by the central core of the distribution which is anchored on Moody's baseline projections. If future realized house prices and interest rates turn out to be more favorable than Moody's projections the Fund will perform better than our base case predicts. Conversely, if future realized house prices and interest rates turn out to be more severe than Moody's projections the Fund will perform worse than our base case predicts.

The results of the alternative scenario analyses in Section V highlighted the sensitivity of the Fund's performance with respect to the projected path of house prices and interest rates. The estimates of tail behavior and in particular the estimated probabilities depend on our stochastic models and the procedures we use for estimating the tail behavior.

B. Basic Data Inputs

The econometric analysis in this Review uses a data extract from FHA's data warehouse as of June 30, 2014. The volume and composition of the existing portfolio are also based on FHA data as of June 30, 2014. The future trends of economic conditions are based on July 2014 forecasts by Moody's Analytics. Future endorsement composition data are based on HUD's projections as of August 2014. While we have reviewed the integrity and consistency of these data and believe the data to be reasonable, we have not audited them for accuracy. The information contained in this Review may not correspond exactly with other published analyses that rely on FHA data compiled at different dates or obtained from other data sources.

Section VIII: Conclusions

This Review presents the results of IFE's analysis of the MMI Fund, excluding loans insured under the Home Equity Conversion Mortgage (HECM) Program. The HECM program was included in the MMI Fund starting in FY 2009, but is analyzed in a separate report. Throughout this Review, we have computed the economic value and the unamortized and amortized IIF for the "Fund," which for the purposes of this report includes all forward loans in the MMI Fund and excludes HECMs.

According to our estimates using a stochastic simulation approach, the Fund has an economic value of \$5.93 billion and unamortized IIF of \$1,154.82 billion as of the end of FY 2014. Furthermore, we project that the economic value will steadily increase after FY 2014 at an average of \$10.60 billion per year to \$80.54 billion by the end of FY 2021. Meanwhile, the unamortized IIF will also increase, at an average compound rate of 3.01 percent per year to the end of FY 2021. The faster rate of increase in economic value than in the IIF primarily reflects the stronger financial performance of new books of business projected to be added to the Fund during the next 7 years. The estimate of the FY 2014 economic value is \$1.91 billion lower than projected in last year's Review, mainly due to the lower endorsement volume. The estimated FY 2020 economic value is also lower than projected in last year's Review by \$17.52 billion.

As a result of the recovery of the housing market and the U.S. economy during the last two years after the financial crisis, the economic value of the Fund has emerged to a positive value and is expected to continue increase in the future, to \$80.54 billion by the end of FY 2021.

The credit quality of recent endorsements under the Fund has shown significant improvement relative to the average credit quality of historical books. Due to capital constraints that arose during the recession, most private mortgage insurance companies in the U.S. have tightened their underwriting standards considerably. This left the FHA as the primary source of housing finance for borrowers with higher LTV ratios. HUD forecasts that the credit quality of future books will gradually return to the compositions experienced in the mid-1990s, before the expansion of the subprime markets. The improved credit-risk profile compared to historical levels significantly improves the projected performance of the Fund.

On Aug 12, 2010, Public Law 111-229, was signed to provide the Secretary of HUD with additional flexibility regarding the mortgage insurance premiums for FHA loans. Specifically, the law increased the limit on the size of the annual mortgage insurance premium that HUD is authorized to charge. FHA subsequently increased both the upfront and the annual mortgage insurance premium rates. FHA also terminated the policy of automatic cancelation of annual insurance premium for loans endorsed after FY 2013 when their LTV amortized to 78 percent. The increased annual premiums, the cancelation of the automatic stop of annual premiums, and

slow projected prepayment rates make the FYs 2012-2014 endorsement books the most financially robust in FHA's portfolio.

As a result of our continuing effort to improve the accuracy of the analysis, several major model enhancements were implemented over the last three years. First, we moved from a deterministic approach to stochastic simulation approach in 2012. The economic value of the Fund is estimated by the expected/average performance of the Fund under 100 possible future economic conditions with different interest rates and house price appreciation rates. Second, we introduced a dynamic simulation algorithm in 2013 to incorporate the time lag from first-time defaults, which improved the default model accuracy. Third, we enhanced the dynamic simulation algorithm this year to endogenously generate estimates of the volume and composition of future streamline refinance loans. This helps to ensure that future loans originated as streamline refinance are accurately captured and the associated MIP revenue correctly measured and included in the MMI Fund.

The passage of HERA prohibited FHA's endorsement of seller-financed downpayment assistance loans as of October 1, 2008. These loans experienced claim rates that are considerably higher than otherwise comparable non-assisted loans. The share of loans with downpayment assistance from non-profit organizations has declined significantly after the passage of HERA and has been almost zero since FY 2010. This continues to help improve the credit quality of the FHA portfolio, particularly the new books of business to be endorsed in the coming years. The significance of eliminating this program is highlighted by our estimate that if non-profit-assisted loans had always been excluded, the economic value of the Fund would have been *positive* \$21.94 billion in FY 2014, instead of the economic value of \$5.93 billion estimated in this report.

Appendix A
Econometric Analysis of
Mortgage Status
Transitions and Terminations

Appendix A: Econometric Analysis of Mortgage Status Transitions and Terminations

This appendix describes the technical details of the econometric models used to estimate the historical and future performance of FHA single-family loans for the FY 2014 Review. The models follow those implemented in FY 2013, with a number of enhancements.

The most important enhancement this year concerns the future origination of streamline refinance loans. We further enhance our dynamic simulation algorithm, according to the status transition models, to generate future streamline refinanced loans based on the mortgage loans that are estimated to terminate as streamline refinanced at a different future point in time. With this enhancement, our calculation of the refinance incentive and collection of mortgage insurance premiums (MIP) for streamline refinanced loans are more accurate. We are able to trace back to the previous endorsement date of the prior FHA loan origination date for all FHA streamline refinanced cases simulated. The endorsement date of previous FHA loans makes a difference in the annual and upfront MIPs. For single-family streamline refinanced loans that are refinanced from FHA loans endorsed before May 31, 2009, the upfront MIP is 0.01% and the annual MIP is 0.55%, both of which are much lower than the current standard MIP schedule of streamline refinanced loans.⁴⁷

For the transition equations, we introduce a new explanatory factor: the first-time buyer flag, an indicator of whether the borrower is a first-time homebuyer. This is an important variable, since the default and prepayment behavior of first-time homebuyers are quite different from non-first-time buyers. We created two dummy variables that combine the first-time buyer with a front-end ratio at or greater than 30 percent. Empirical evidence shows that surpassing the 30 percent front-end ratio impacts borrower behavior.

The status transition model has the same structure as the AR 2013 model. We still split the transition states of self-cure and loan-modification cure (“mod-cured”) into two separate paths to better capture the differences in the factors that drive these two cure behaviors. In AR 2012, loans that are cured by themselves or by loan modification shared the same path of future transitions. For example, if a cured loan stays in the cured status in the next period, the type of the cure at the next period is not specified. In AR 2013, we separated the paths of loans that are cured in different ways—a self-cured loan that stays in the cured status is identified as self-cured rather than cured, and a mod-cured loan that stays in the cured status is identified as mod-cured. Consequently, their subsequent transition probabilities are different.

We used the purchase-only (PO) home price indices (HPIs) in AR 2014 following the change introduced in AR 2013. Before AR 2013, due to its long duration and wide location coverage,

⁴⁷ See Mortgagee Letter 2012-4.

the FHFA (formerly OFHEO) all-transaction HPIs were used in the model estimation and forecasting. In 2013, FHFA expanded the geographical coverage of its PO HPI to 100. Since the PO HPI is calculated by excluding appraised values and instead relies exclusively on actual sales prices, it is free from any appraisal bias due to the all-transaction HPI. The PO HPI is considered a more accurate reflection of actual market conditions. By using the PO HPI, variables, such as current LTV, are more accurately calculated.

We continued to adjust the weights of default-to-default transitions for the estimation sample during FY 2009Q4 to FY 2013Q4, enabling us to utilize observations during this period to estimate other default transitions, such as default-to-prepay, default-to-self-cure and default-to-modification. The weight adjustment algorithm helps mitigate the biases introduced by low default-to-claim transitions during this period, which are due to foreclosure moratoria, court backlogs and other policy effects.

The choice-based sampling scheme was the same as that in AR 2013. In previous Reviews, a 20 percent random sample was constructed for product type 1 (FRM30) and 100 percent for other product types. In AR 2013, a two-stage choice-based sampling scheme was applied to construct the estimation sample, while the sampling rates were determined by the terminal status of each loan and its status in each period. The reason for applying the choice-based sampling scheme is to capture all of the rare events (i.e., default, claim and cure) to obtain a more robust estimation result.

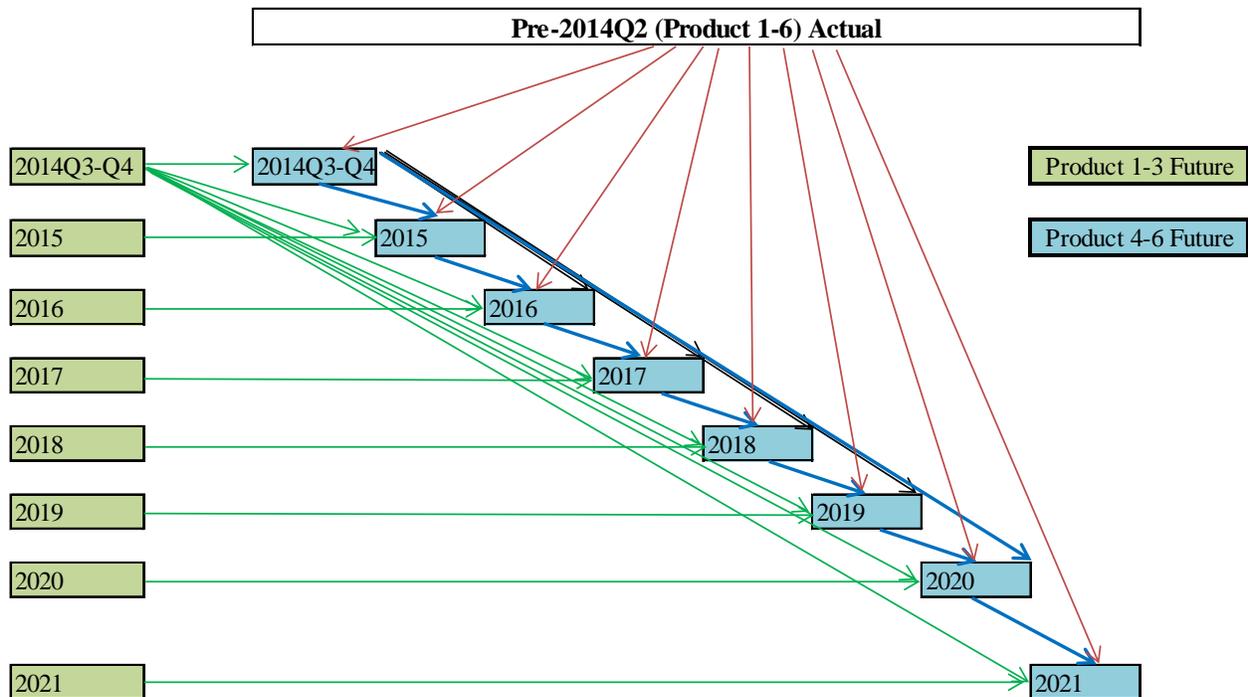
We modified the estimation period to exclude unreliable observations. For the default transition equations (i.e., default to prepay, default to claim, default to self-cured, and default to mod-cured), the observations between the second quarter of FY 2006 to the third quarter of FY 2007 were excluded. During 2006 and 2007, the database underwent transformation. During the system transformation, information regarding certain state transitions was lost for defaulted loans. We excluded these observations to avoid biased and inaccurate estimations.

Section I of this appendix describes the details of our new Streamline Refinance Simulation. Section II summarizes the model specification and estimation issues arising from the analysis of FHA mortgage status transitions and ultimate claim and prepayment rates. We also discuss issues related to the measurement of borrower default episodes and prepayment and claim terminations. In AR 2014, we continued to apply a similar multinomial logistic probability framework used to manage competing risks. This model is now “built up” by estimating separate binomial logistic models for each type of mortgage status transition. We present the mathematical derivation of the multinomial logistic probabilities from separate binomial logit estimates. Section III describes explanatory variables for estimation. The econometric estimates of the binomial logistic model coefficients are presented in Section IV.

I. Streamline Refinance Dynamic Algorithm

The algorithm of dynamically simulating streamline refinance loan originations (Products 4-6 Future) can be illustrated by the following diagram. This model enhancement allows us to determine whether a future SR loan is originated from a fully underwritten loan prior to May 31, 2009, as well as determine the volumes and compositions of future SR loans.

Exhibit A-1: Streamline Refinance Dynamic Simulation



Below is the 5-step procedure for simulating future originations of streamline refinanced loans. Please refer to Section II-E for the definition of each product.

1. Simulate SR loans originated from existing books and generate initial input files for products 4 to 6 for FYs 2014-2021.
2. Simulate SR loans originated from future books of products 1 to 3 in future years. Add these SR loans into the origination files of products 4 to 6 for FYs 2014-2021.
3. Simulate using products 4 to 6 of the first forecast year (FY2015), and update origination files of products 4 to 6 for the second (FY 2016) and subsequent forecast quarters.
4. Recursively apply step 3 until the origination files of products 4-6 until all forecast years are complete.

With the implementation of this dynamic simulation, we are able to trace back the information of the previous loan from which the streamline refinanced loan originated from. This information includes whether the previous loan is fully underwritten or a streamline-refinance loan, as well as the endorsement date of each previous loan. This information enables us to accommodate the premium structures outlined in Mortgagee Letter 2012-4. These apply different upfront and annual MIPs to streamline refinance loans depending on whether they are refinancing existing FHA loans endorsed before May 31, 2009.

II. Model Specification and Estimation Issues

A. Specification of FHA Mortgage Status Transition and Termination Models

Prior to the FY 2010 Review, we used a competing-risk framework based on multinomial logistic models for quarterly conditional probabilities of prepayment and claim terminations. The general approach was based on the multinomial logistic models developed by Calhoun and Deng (2002). The multinomial model recognizes the competing risks of prepayment and claim terminations.

Starting in the FY 2010 Review, we introduced a third “competing risk”: 90-day delinquency, which we call “default.” It is a competing risk in the sense that if the loan is in default for a given quarter, it cannot also be prepaid or claimed during the same quarter. This new transition state was possible after FHA combined multiple data sources, allowing for the emergence of historical data on new, 90-day default episodes that have occurred on all endorsed mortgages since FY 1990 Q1. The date from which a loan is first reported to be 90-or-more days in arrears is used to identify the start of a default episode. This default episode continues until the default episode ends by cure or the loan terminates through claim or prepayment. Under our approach, loans that enter a policy quarter as 90-or-more days delinquent are deemed to be in default status. Similarly, active loans that are not in a 90-day default episode at the beginning of the quarter are classified as current, even if they go 90-days delinquent during that quarter.

Exhibit A-2 highlights the status transitions and the loss severity model components that we have modeled for the FY 2014 Review.

Tracking loans with and without prior default episodes or prior loan modification as separate loan status categories introduces a form of path dependency into the analysis; that is, subsequent behavior depends on whether they were previously in default or were modified. Loans in current status (C) at the beginning of a quarter can either transition to default status (D) at the start of the next quarter, terminate as a prepayment to a FHA streamline refinance product (SR) or as a prepayment (PRE) for any reason other than SR, default or cure in the same quarter (CX), or continue in their current status.

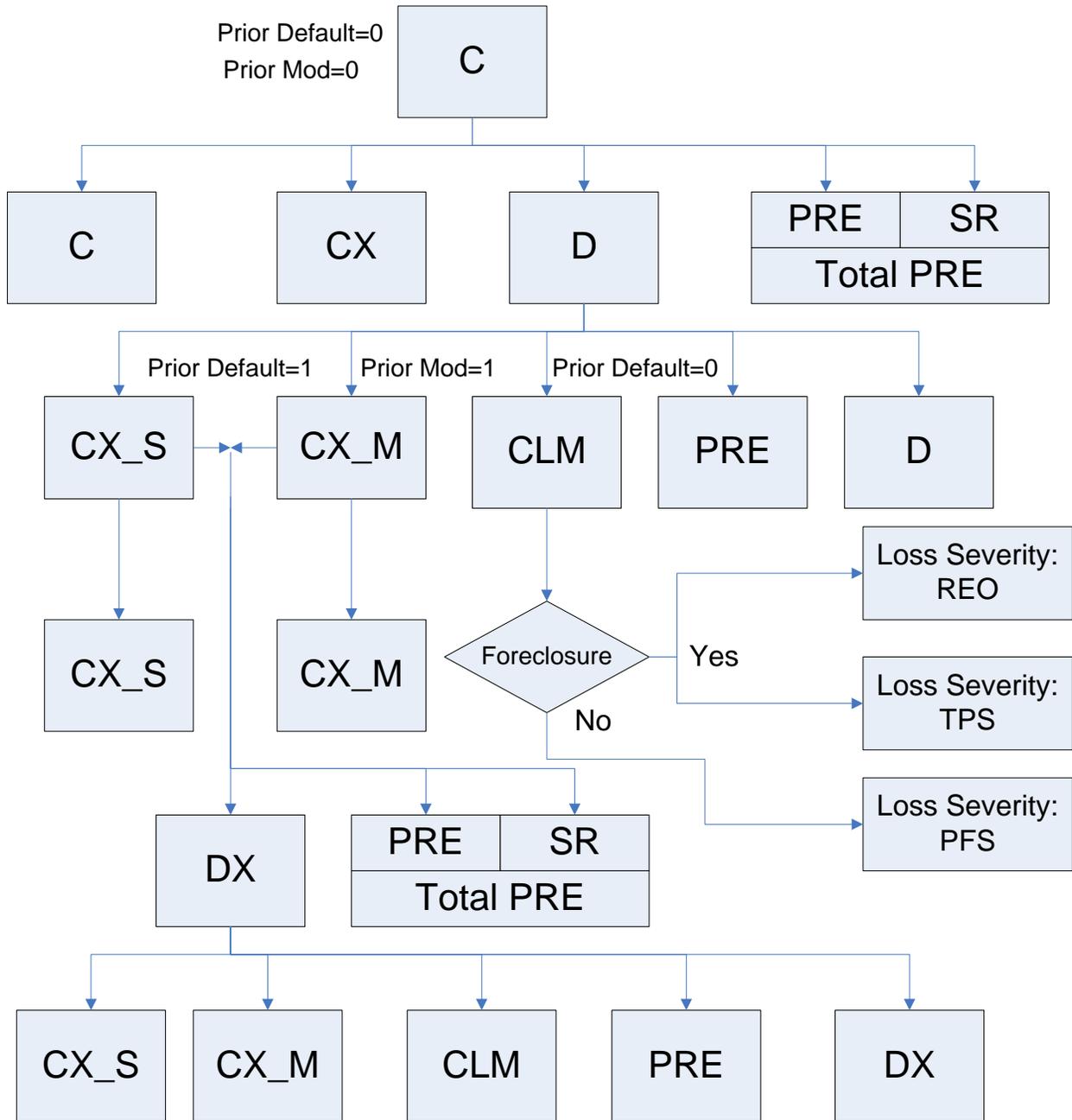
The transition from current into SR rather than into a non-FHA prepayment allows feedback into an ongoing portfolio where future additions to the portfolio are accounted for. Both types exit the portfolio, but when we simulate the future economic values of the MMIF, the SR loans are brought back into these future books of business. This mechanism does not apply, however, when the current value of the MMIF is computed, because future books are not included in the computation of the value of the current portfolio.

All loans that have been in 90-day delinquency in their lifetime and that have returned to their current status are flagged with an “X” and assigned to a separate current status, “CX”: this is the previous default flag. This also applies when a loan goes into and out of 90-days during the same quarter. Loans transition from default status D to status CX along two possible paths, depending on whether they self-cure (CX_S) or cure with a loan modification (CX_M). Self-cures give rise to repayment plans to account for the arrearages, and loan modifications that have principal forgiveness give rise to partial claims.

Starting in the 2013 Review, a prior loan modification flag is included to identify the cure type. Once a loan is modified, the prior modification flag is permanently activated to distinguish between self-cured and mod-cured. This approach models the transition to these cure types to better identify and model the mix of cure types. The transition equation to project future transitions for these loans is differentiated by using the flag as an explanatory variable in the equations.

Similarly, loans in current status CX with prior default episodes that re-default are assigned to status DX, the status of default with a prior default episode. As with loans in status D, loans in status DX may also terminate as claims or prepayments. Note that the prior default episode and prior loan modification are modeled as flags that enter the transition models as explanatory variables. The flags are kept on these loans to distinguish their transition probabilities from un-flagged loans. Similarly, DX has different transition probabilities from D, for purposes of modeling the transitions to the next quarter. Managing the number of transitions is very important for the efficiency of model estimation, especially in the simulations of future performance.

Exhibit A-2: Loan Status Transitions Framework



In summary, from the current status, there are five possible transitions: CUR_CUR, CUR_CX (a loan that goes 90 days delinquent within a quarter but is less than 90 days delinquent at the beginning of the next quarter; typically this is a self-cure, because modifications normally take longer to execute), CUR_D, CUR_PRE and CUR_SR. Note that the underline means “transition to,” as in CUR (current) transitions to D (default). Since the probabilities for each of these transitions must sum to unity, only four of these transition probabilities need to be estimated. We do not estimate the CUR_CUR transition probability, inferring it instead from the other four transitions. Also, we do not introduce separate transitions if the loan starts in a CX status, as that would require three more transition probabilities to estimate and manage in the simulations. Instead, we incorporated right-hand indicator variables that account for prior default episodes and prior loan modifications. In other words, we have not expanded the state space to keep track of the complete data set of prior default episodes, accounting for the different behavior of these loans. In the case of the current status (CUR), we distinguish between “clean” current status (C) and “blemished” current status (CX).

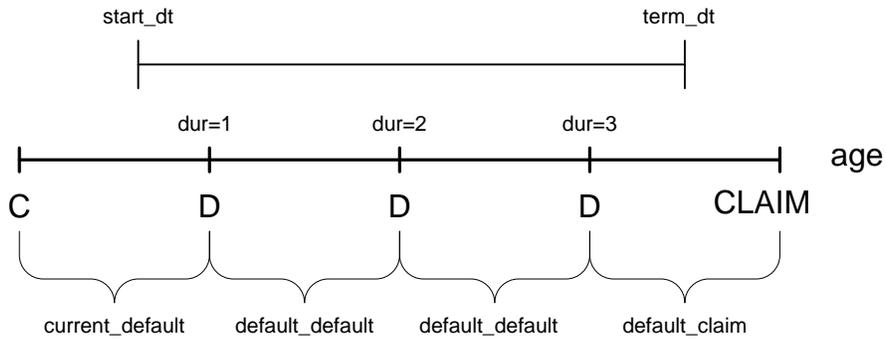
Similarly, there are five possible transitions from a default status: D_D, D_CLM, D_PRE, D_CX_S and D_CX_M, with the latter two reflecting self-cure and mod-cure. The D_SR transition is not allowed, because loans in default status cannot streamline refinance. Since the sum of the transition probabilities must sum to unity, we did not estimate the D_D transition, but inferred its probability from the other four transitions. And as above, we used right-hand variables to indicate prior default and modification statuses.

In all, there are ten transitions. There are five possible transitions from current status and five from default. Two of the transition probabilities are inferred from the others, so there are eight transition probabilities to estimate for each of the 6 product types. Hence, there are 48 equations to estimate.

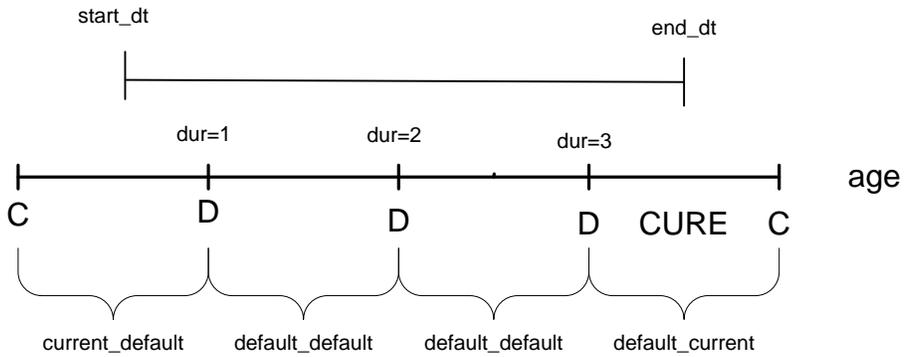
Exhibit A-3 shows five examples of when a loan starts a 90+ episode (“start_dt”) and when it ends (“term_dt”) as a claim, as in Example 1, or ends as a prepayment, as in Example 3. The end of a default episode is denoted, “end_dt,” when it cures, as in Example 2. A default episode can also be “censored” if it does not end at the end of the sample observation period, as in Example 4. Note that these examples also help illustrate the notion of default duration (“dur”), which was introduced in the 2010 Review as an explanatory variable in the transition equations. Example 5 illustrates the situation of a loan going into a 90-day episode within a quarter but is not 90+ at the end of the quarter. Based on our framework, the loan would be in status CX_S, a self-cure, without the status D. In this situation, we call the subsequent status CX_S a “blemished” current status. An example of this situation is if a loan is 60-days delinquent prior to the quarter, goes to 90- or even 120-days delinquent in the first months of the quarter, resulting in the arrearages being paid in the last month of the quarter.

Exhibit A-3: Examples of Loan Transition Types

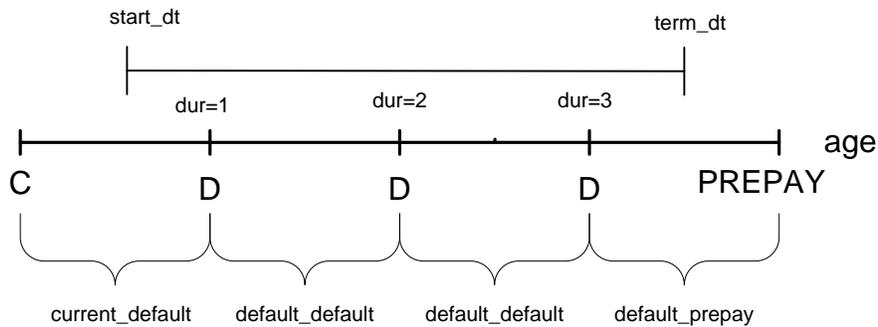
Example 1 : current-to-default / default-to-claim



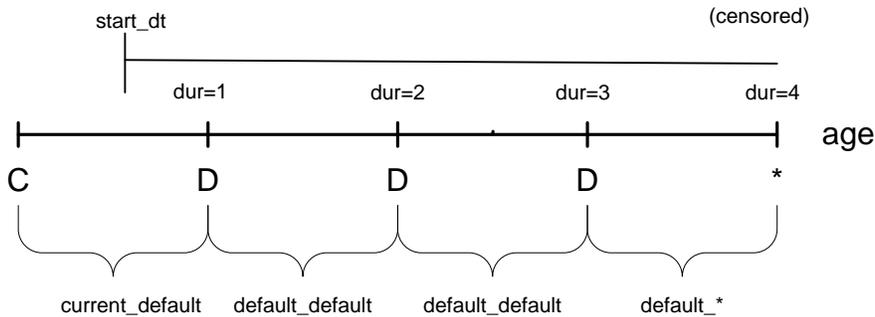
Example 2 : current-to-default / default-to-current



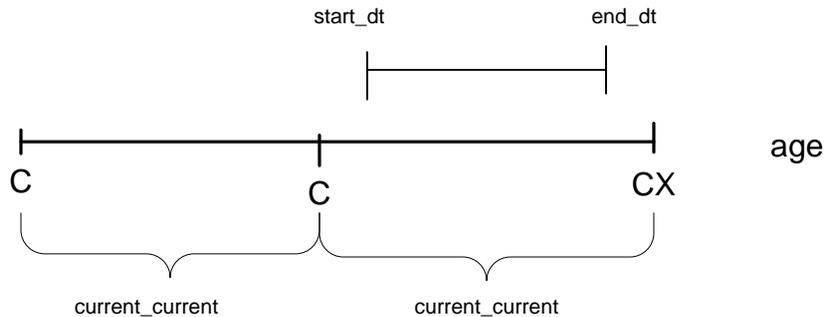
Example 3: current-to-default / default-to-prepay



Example 4: current-to-default / censored



Example 5: current-to-current



B. Specification of Multinomial Logistic Models

As summarized above, the status transition framework results in two sets of competing risks: one for loans in current status and the other for loans in default status. For loans that are current at the start of the quarter, the competing risks are prepayment, a transition to default status, or remaining current, as was shown above in the first layer of transitions in Exhibit A-2. For loans in default status at the start of a quarter, the competing risks are claim, prepayment (delinquent borrowers are ineligible for streamline refinance), transition to current statuses (self-cure or cured by a loan modification), or remaining in default status, as shown in the second layer of transitions in Exhibit A-2. The number of competing risks includes three possible current types (C, CX_S and CX_M, where CX_S and CX_M are current but with a prior 90+ default episode) and two possible prepayment types (streamline refinance (SR) and other prepayment (PRE), the sum of which is Total PRE). These are shown in the first layer of transitions of Exhibit A-2. There are also two possible cure types, self-cure (S) and loan modification (M), as shown in the

second layer of transitions of Exhibit A-2. This gives rise to eight possible transition probabilities requiring estimation.

We specified multinomial logistic models of quarterly conditional probabilities for transitions from current to prepayment, streamline refinance, default, blemished current, or remaining current, as well as for transitions from default to claim, prepayment, back to current, or remaining in default. The corresponding mathematical expressions for the conditional probabilities over the time interval, t to $t + 1$, for loans starting in a “clean” current status in quarter t to other types of prepayment, streamline refinance, default, blemished current, remain “clean” current, respectively, in the subsequent quarter, $t + 1$, are given by:

$$\pi_{PRE}^{CUR}(t) = \frac{e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \quad (1a)$$

$$\pi_{SR}^{CUR}(t) = \frac{e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \quad (1b)$$

$$\pi_{DEF}^{CUR}(t) = \frac{e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \quad (1c)$$

$$\pi_{CUR}^{CUR}(t) = \frac{1}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \quad (1d)$$

We further expand quarterly conditional probabilities (1d) into two types, C (“clean current”) and CX (“blemished current”), by using nested logistic models:

$$\pi_{CX}^C(t) = \frac{e^{\alpha_{CX}^C + X_{CX}^C(t)\beta_{CX}^C}}{1 + e^{\alpha_{CX}^C + X_{CX}^C(t)\beta_{CX}^C}} \quad (1e)$$

$$\pi_C^C(t) = \frac{1}{1 + e^{\alpha_{CX}^C + X_{CX}^C(t)\beta_{CX}^C}} \quad (1f)$$

The corresponding probabilities for loans starting in a default status transitioning to claim, prepayment, current (self-cured without a partial claim, such as with a repayment plan), current (via a partial-claim modification), and continuing in default status are given by the respective equations:

$$\pi_{CLM}^{DEF}(t) = \frac{e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}} + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}} + e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}} + e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}} \quad (2a)$$

$$\pi_{PRE}^{DEF}(t) = \frac{e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}} + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}} + e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}} + e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}} \quad (2b)$$

$$\pi_{CUR_S}^{DEF}(t) = \frac{e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}} + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}} + e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}} + e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}} \quad (2c)$$

$$\pi_{CUR_M}^{DEF}(t) = \frac{e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}} + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}} + e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}} + e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}} \quad (2d)$$

$$\pi_{DEF}^{DEF}(t) = \frac{1}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}} + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}} + e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}} + e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}} \quad (2e)$$

The constant terms α_f^i and coefficient vectors β_f^i are the parameters to be estimated for the multinomial logistic model, where starting status i indicating current (CUR) or default (DEF); and ending status f indicating claim (CLM), prepayment (PRE), streamline refinance (SR), default, remain current without getting into 90-day delinquency (C), and self-cure in the same quarter (CX), two types of current/cure (CUR) if coming from a default status in the previous quarter, or default (DEF). We use $X_f^i(t)$ to denote the vector of explanatory variables for the conditional probability of making a transition from starting status i to ending status f . Some components of the $X_f^i(t)$ are constant over the life of the loan and, therefore, do not vary with time period t . The “dynamic” or time-varying explanatory variables in $X_f^i(t)$ include mortgage age, the duration of the default episode for loans in default status, and the existence of prior default episodes.

As illustrated in Exhibit A-2, for the FY 2014 Actuarial Review projections, we ultimately stratified initial current status (CUR) by whether the loan had a prior default episode (CUR_X). As discussed further below, the econometric equations (1a) - (1d) and (3a) - (3c) for loans in current status (CUR) presented above were estimated using pooled samples of loans with and without prior default episodes or prior loan modification. The explanatory variables in $X_f^i(t)$ include (1) an indicator (dummy variable) for whether the loans had a prior loan modification, and (2) a continuous variable representing the number of quarters since a loan’s existence following the last default episode (cx_time).

We distinguish the current-to-current status transition into three possible ending statuses depending on whether the loan experienced: (1) both prior default episodes and loan modifications (CX_M), (2) prior default episodes but not loan modifications (CX_S) and (3) none of the above (C). As noted, subsequent transitions from current status only use a current status (C) with no 90-day delinquency and prior loan modification distinction. The econometric equations (1a – 1d) for loans in current status (C) presented above were estimated using pooled samples of loans with or without prior default episodes or loan modifications. Thus, modeling two types of current-to-current transitions C to C and C to CX is a nested logistic model [Equations (1e) and (1f)] while modeling the first level current-to-current transition is treated as

an alternative event of current-to-default, current-to-streamline refinance, current-to-prepayment and current-to-claim.

Following the 2013 Review, we expanded the possible ending statuses for cures to include two possible cure types: 1) self-cure or non-mod foreclosure alternative (CUR_S), and 2) modification cure (CUR_M) and subsequent transitions from current status we use a combined current status (CUR) definition. However, the prior default episode and loan modification flags identify the sub-type of the current status. Below are the three sub-types of a loan with a current status related to the loan modification flag:

Current Transitions (Current to Default, Prepay, SR)		
CX_Time	Prior Loan Modification Flag	Sub-Type
0	0	Current loan which was never in default episode or loan modification (C)
>0	0	Current loan which had been in default episodes but self-cured (CX_S)
>0	1	Current loan which had been in default episodes but cured by loan modification (CX_M)

C. Computation of Multinomial Logit Parameters from Binomial Logit Parameters

As in prior-year Reviews, we apply the approach developed by Begg and Gray (1984), in which we estimate separate binomial logistic models for each possible transition type and then recombine the estimates to derive the multinomial logistic probabilities. Begg and Gray (1984) applied Bayes Law for conditional probabilities to demonstrate that the values of parameters α_f^i and β_f^i estimated from separate binomial logistic (BNL) models are parametrically equivalent to those for the corresponding multinomial logistic (MNL) model once appropriate calculations are performed. The conditional probabilities for current-to-prepay and current-to-default transitions for separate BNL models for loans in current status at the start of quarter t are given, respectively, by:

$$\Pi_{PRE}^{CUR}(t) = \frac{e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}}} \tag{3a}$$

$$\Pi_{SR}^{CUR}(t) = \frac{e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}}}{1 + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}}} \quad (3b)$$

$$\Pi_{DEF}^{CUR}(t) = \frac{e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}}{1 + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \quad (3c)$$

$$\Pi_{CX}^{CUR}(t) = \frac{e^{\alpha_{CX}^{CUR} + X_{CX}^{CUR}(t)\beta_{CX}^{CUR}}}{1 + e^{\alpha_{CX}^{CUR} + X_{CX}^{CUR}(t)\beta_{CX}^{CUR}}} \quad (3d)$$

The upper-case Π indicates the binomial logistic probability and distinguishes it from the lower-case π that was used above to denote the multinomial logistic probabilities. The corresponding binomial probabilities for transitions from default status to claim, prepayment, or current status are given by:

$$\Pi_{CLM}^{DEF}(t) = \frac{e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}} \quad (4a)$$

$$\Pi_{PRE}^{DEF}(t) = \frac{e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}}{1 + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}} \quad (4b)$$

$$\Pi_{CUR_S}^{DEF}(t) = \frac{e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}}}{1 + e^{\alpha_{CUR_S}^{DEF} + X_{CUR_S}^{DEF}(t)\beta_{CUR_S}^{DEF}}} \quad (4c)$$

$$\Pi_{CUR_M}^{DEF}(t) = \frac{e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}}{1 + e^{\alpha_{CUR_M}^{DEF} + X_{CUR_M}^{DEF}(t)\beta_{CUR_M}^{DEF}}} \quad (4d)$$

Estimation of the binomial logistic (BNL) probabilities in (3a) - (3c) and (4a) - (4d) produces estimates of parameters α_f^i and β_f^i that can be substituted directly into equations (1a) - (1c) and (2a) - (2d) to derive the corresponding multinomial logistic (MNL) probabilities. Also, estimation of nested logistic probabilities in (3d) and along with the first level of probability (1d) can derive the corresponding multinomial logistic (MNL) probabilities.

D. Loan Transition and Event Data

We used loan-level data to construct quarterly loan event histories by combining mortgage origination information with contemporaneous values of time-dependent factors. In the process of creating quarterly event histories, each loan contributed an observed “transition” for every quarter from origination up to and including the period of mortgage termination, or until the last time period of the historical data sample. The term “transition” is used here to refer to any

situation in which a loan remains active and the loan status changes prior to the start of the next quarter, or in which terminal claim or prepayment events are observed in the current quarter.

The FHA single-family data warehouse records each loan for which insurance was endorsed and includes data fields that record changes in the status of the loan. The historical data used in model estimation for this Actuarial Review is based on an extract from FHA's database as of March 31, 2014.

E. Data Samples

There are approximately 29.73 million single-family loans originated between the first quarter of FY 1975 and the second quarter of FY 2014. Sampling enhances the efficiency of model estimation. In credit risk modeling, a choice-based sample is commonly used for large populations with relatively rare events of interest. For this year's Review, we used a two-stage choice-based sampling process for estimating the transition equations where the sampling rates are determined by the terminal status of each loan and its status at each period.

Selected Literature Review

The sampling approach we used this year is supported by the literature, which is summarized here.

Manski and Lerman's paper in *Econometrica*, "The Estimation of Choice Probabilities from Choice Based Samples" (1977) is one of the first papers to address the topic of choice-based samples. Before that, sampling was mainly used for independent variables, instead of for dependent variables. Because estimating the parameters of a probabilistic choice model are conditional on the independent variables, the sampling technique generally does not produce bias. Manski and Lerman prove that for a general probabilistic choice model, when the choice-based samples are weighted correspondingly, the maximum likelihood estimator is consistent and converges to the un-sampled estimator.

Scott and Wild (1985) discuss the response-based sample in a logistic model framework, and found that although the weighted estimators might be less efficient, the sampling produces unbiased parameter estimates of the logistic coefficients.

Xie and Manski (1988, 1989) argue that although under the logistic model, the random sampling and response-based sampling maximum likelihood estimators coincide for all parameters except the intercept, modelers should avoid assuming the logistic model form and analyzing the response-based samples without adjusting the sample weights. The weighted maximum likelihood method estimates a constrained best predictor of the binary response.

Choice-Based Sample for MMI Transition Models

As in the 2013 Review, for 30-year FRMs, we used a two-stage process to implement choice-based sampling:

1. Over-sample the bad loans, where a bad loan is defined as a loan that has ever been 90-day delinquent:
 - a. Loan-level sampling rate of good loans = 10%
 - b. Loan-level sampling rate of bad loans = 100%
2. Over-sample the bad quarters, where a bad quarter is defined as the quarter that a loan becomes a first-time 90-day delinquent and all subsequent performance quarters:
 - a. Quarterly loan-level sampling rate of non-default quarters = 10%
 - b. Quarterly loan-level sampling rate of default and subsequent quarters = 100%

With this two-stage sampling process, we calculate the following sampling probability matrix illustrating the ultimate sampling probability for loan-quarter combinations. The corresponding weights we used are the reciprocal of the probabilities of selection. For the FRM-SR, the probabilities for the Good Quarters are 25%, as shown in Exhibit A-4 below.

Sampling Rate	Good Loan	Bad Loan
Good Quarter	1%	10%
Bad Quarter	N/A	100%

We used loans originated from FY 1996 through FY 2013Q4 to estimate the status transition models starting in current and default statuses that transition to other statuses, corresponding to the loan cohorts for which complete data were available on new 90-day default episodes. These data were used to generate quarterly loan-level event histories to the end of the sampling period or when the loan reached claim, full prepayment, or maturation.

Estimation and forecasting was undertaken separately for each of the following six FHA mortgage product types:

Product 1	FRM30	Fixed-rate 30-year fully underwritten purchase and refinance
Product 2	FRM15	Fixed-rate 15-year fully underwritten purchase and refinance
Product 3	ARM	Adjustable-rate fully underwritten purchase and refinance
Product 4	FRM30_SR	Fixed-rate 30-year streamlined refinance
Product 5	FRM15_SR	Fixed-rate 15-year streamlined refinance
Product 6	ARM_SR	Adjustable-rate streamlined refinance

The sampling rate scheme used for each product to produce the estimation dataset is summarized in Exhibit A-4.

Exhibit A-4: Choice-Based Sampling Scheme

Product Number	Product Type	Sampling Scheme
Product 1	FRM30	1) Clean periods of clean loans ⁴⁸ : 1% 2) Clean periods of non-clean loans ⁴⁹ : 10% 3) Non-clean periods of non-clean loans ⁵⁰ : 100%
Product 2	FRM15	100% for all loans
Product 3	ARM	100% for all loans
Product 4	FRM30_SR	1) Clean periods of clean loans: 6.25% 2) Clean periods of non-clean loans: 25% 3) Non-clean periods of non-clean loans: 100%
Product 5	FRM15_SR	100% for all loans
Product 6	ARM_SR	100% for all loans

F. Weight Adjustment for Default Transitions

In order to limit the impact of policy actions, such as the foreclosure moratorium and mass modification programs taken by government agencies, lenders/servicers and other mortgage market participants, who are likely to under-estimate the true default-to-claim transition, we cut off the default transition data at FY 2009Q3 for this year's estimation.

However, by cutting off the estimation data at such an early time, we may omit legitimate observations of transitions, such as default-to-prepay, default-to-self-cure and default-to-modification, which are competing transitions vs. default-to-claim. Including these observations would create an under-estimation bias, because of the artificially high default inventory due to foreclosure moratoria and other factors, including a high rate of new foreclosures. We used the following approach to correct this bias:

1. Estimate the default-to-claim transition using observations up to FY 2009Q3.
2. Using this equation, generate an out-of-sample estimation for the default-to-claim transition until FY 2013Q4 and then:

⁴⁸ "Clean Loans" means loans which have never defaulted, prepaid or claimed throughout the entire history or up to the most current time.

⁴⁹ "Clean periods of non-clean loan" means the periods before a loan first becomes default, prepay or claim during the life of the loan.

⁵⁰ "Non-clean periods of non-clean loan" means the periods after a loan first becomes default, prepay or claim during the life of the loan.

- a. Adjust the default-to-default transition weight, using the cumulative difference between the predicted and actual default-to-claim transition; and
- b. Estimate the remaining default-to-prepay, default-to-self cure and default-to-modification cure equations over the entire period with the adjusted weight for the default-to-default transition, which is residual and not estimated directly.

This procedure allows the latter three transition probabilities to be estimated over the entire period without being influenced by out-of-the-ordinary loans that had accumulated in the default status instead of going to claim.

III. Explanatory Variables

Five categories of explanatory variables were used to estimate the various transition equations:

- Fixed initial loan characteristics including mortgage product type, property type, purpose of loan (home purchase or refinance), amortization term, origination year and quarter, original loan-to-value (LTV) ratio, original loan amount, original mortgage interest rate, spread at origination (SATO), and relative house price level by geographic location (MSA, state or Census division);
- Fixed initial borrower characteristics, including borrower credit scores and indicators of the source of down payment assistance;
- Dynamic variables based entirely on loan information, including mortgage age, duration of default episode, whether a loan has had a prior default episode and number of quarters since the end of the latest default episode, season of the year, scheduled amortization of the loan balance, whether a loan has had a prior loan modification, percentage of monthly payment reduction resulting from loan modifications, the number of prior quarters the prepayment option was in the money, and the cumulative number of quarters that a property has been “underwater”; and
- Dynamic variables derived by combining loan information with external economic data, e.g., refinance incentive, which is the difference between monthly payments calculated by the (contract) mortgage interest rate and the prevailing market rate.
- Dynamic macroeconomic variables, including the unemployment rate, the spread of the mortgage rate to the 10-year Constant Maturity Treasury rate, and house price indexes.

In some cases the two types of dynamic variables are combined, as in the case of adjustable-rate mortgages where external data on changes in 1-year Treasury yields are used to update the original coupon rates and payment amounts in accordance with standard FHA loan contract features. This in turn affects the amortization schedules of the loans.

We account for variation in FHA loss mitigation activities by estimating two separate cure-type equations, equations (2c), and (2d) above. The model estimates the impact of prior default episodes and develops separate actuarial projections for loans with and without prior default episodes and is therefore more sensitive to the conditions during the recent housing crisis.

Exhibits A-5.1 through A-5.6 summarize the explanatory variables that were used in the statistical modeling of loan status transitions and present the coefficient estimates for the 48 binomial logistic models. While we continue to employ categorical (dummy) variables for those variables that are binary, such as the indicator of prior default episodes, we converted most categorical variables into continuous linear or linear spline variables, such as the refinance incentive, the burnout factor and the yield curve slope. Linear forms were used when they seemed reasonable and improved statistical fit; otherwise the spline forms were used to reflect nonlinearities. Also we constrained some variables, such as the current loan-to-value ratio, at certain levels because of thin data for these variables in the extreme regions. At some point, the borrower is sufficiently underwater and incremental “underwaterness” does not matter.

This year we have included several new explanatory variables, which improve the in-sample fit significantly. Most of these variables were introduced as splines. Additional details on each set of variables are provided below, with the newly added variables first.

First-Time Buyer

The first-time buyer dummy variable indicates whether the borrower was a first-time homebuyer or not. This is an important variable, since the default and prepay behavior of the first-time homebuyer and non-first-time buyer are quite different. We also introduce two dummy variables that interact the first-time buyer with the front-end debt ratio of 30% or higher, because a 30% or higher front-end ratio makes a difference in borrower behavior. The variables are defined as front-end ratio > 30% and first-time buyer, and front-end ratio > 30% and non-first-time buyer .

Purchase-Only HPI

As in the 2013 Review, we use the Purchase-Only (PO) Home Price Index (HPI) to replace the all-transaction HPI which was used in previous Reviews. The PO series for large number of local markets were not available from FHFA for Reviews before 2013. The PO Index is based on

repeat sales at market prices and does not use any appraised values. As such, it provides a more reliable measure of housing market conditions.

Prior Loan Modification Indicator

As specified in section II, we separated the transition paths of loans which were cured by themselves or by loan modification and for the latter we introduced a prior loan modification indicator. The prior loan modification indicator is equal to 1 after the flag of loan modification cure is turned on (i.e., $CX_M = 1$), and remains at 1 until the termination or payoff of the loan. For example, if a loan receives a loan modification and is cured in its 20th quarter, the prior loan modification indicator is equal to 1 and remains 1 starting from the 21st quarter.

Loan Modification Payment Change

The purpose of loan modification is to change one or more of the terms of a loan. This allows the loan to be reinstated, and results in a payment the borrower can afford. Therefore, the percentage change of monthly payment resulting from a loan modification will affect the borrower's capacity to service the loan, and hence impact the future transitions of the loan.

Since the financial crisis and the crash of the U.S. housing market, loan modification has been widely used to reduce foreclosures. At the beginning of the financial crisis, most loan modifications were in the form of forbearance, resulting ultimately in monthly payment increases. In the subsequent years, modifications of the terms such as interest rate and amortization schedule became the most frequent types of modification. Within all the major types of loan modifications, forbearance is the only type which would result in monthly payment increases. As mentioned above, most of the forbearances occurred at the beginning of the financial crisis and the number of forbearances became insignificant since 2010. Since forbearance is not expected to be a major modification type in the future, we floor the percentage of monthly payment change to zero so that the monthly payment change resulting from forbearance will not impact model estimation and its forecasts.

The details of the loan modification payment change are not retrievable for some of the modified loans. In such cases, we created an indicator that identifies when this information is missing.

Number of Quarters Since the End of Last Default Episode

Following last year's change, we replaced the prior default episode indicator by the number of quarters since the end of the latest default episode (CX_TIME) for transitions in the current status. The reason is that we believe the duration since the latest default episode will affect future transitions. For example, a loan which was recently cured from a default episode may have a higher probability of re-defaulting compared to a loan which has been cured for a long time.

Evidence shows that not only past default experience, but also the duration of time since its cure affects the probabilities of future transitions.

The CX_TIME is set to zero at the origination of each loan until the end of its first default episode. It becomes 1 after the end of the default episode, and keeps increasing quarterly until the start of next default episode. For example, if a loan experiences a second default episode, CX_TIME continues to increase until the start of the second default episode, and it is set to 0 during the second default episode. After the end of the second default episode, it is reset to 1 and continues to accumulate until the next default. We modeled this variable as a spline function, which depicts its declining marginal effect the longer the time since the last default episode.

Mortgage Premium (Refinance Incentive)

In previous Reviews, the refinance incentive was proxied by the relative spread between the mortgage contract interest rate and the current market mortgage rate. Starting in the 2013 Review, we use the percentage difference, specified by $Refi_incentive(t)$, between the monthly payment of a potential refinance $PMT_1(t)$ relative to the current payment $PMT_0(t)$:

$$Refi_incentive(t) = 100 * \frac{PMT_0(t) - PMT_1(t)}{PMT_0(t)}. \quad (5)$$

This variable is an approximation to the refinance option value of the mortgage given by the difference between the present value of the “anticipated” future stream of mortgage payments discounted at the current market rate of interest and the present value of the mortgage evaluated at the current note rate. Additional details are given in Deng, Quigley, and Van Order (2000) and Calhoun and Deng (2002).

For the transition into the FHA streamline refinance mortgage, we use as the refinancing option an FHA mortgage, by definition. For all other transitions we use the payment from a market mortgage, assumed to be a GSE mortgage.

Also, we add the annual FHA mortgage insurance premium (MIP) to the mortgage rate, in both the current FHA loan and the potential new FHA loan (for SR), as follows:

$$effect_coupon_rate(t) = C(t) + annual\ MIP(t), \quad (6)$$

where $C(t)$ is the coupon rate for the extant FHA loan.

For the effective GSE refinancing rate, we want to add the effective refinancing points to the contract rate, which translates the one-time points to an equivalent interest rate spread over time. FHFA publishes both the contract rate and this effective rate, and we calculate the spread difference and project it in our analysis. Therefore, we define the effective refinancing cost

avg_refi_cost as the spread between the FRM30 effective rate and the contract rate provided in the FHFA survey:

$$GSE_refi_rate(t) = R(t) + avg_refi_cost, \quad (7)$$

Assuming refinancing costs are the same for both the GSE and FHA refinancings, the effective rate for refinancing into an FHA loan is then built onto this GSE refinancing rate, by adding the average FHA to GSE spread and the new annual MIP:

$$FHA_refi_rate(t) = GSE_refi_rate(t) + avg_FHA_GSE_sprd + annual_MIP, \quad (8)$$

The payment on the current FHA loan is $PMT_0(t)$. Using the above effective refinance rates, we compute “effective” monthly mortgage payments for the current and the prospective new refinancing loans $PMT_1(t)$, which have a prefix denoting whether they are the GSE or FHA loan options. The refinance incentive for a GSE refinancing loan is:

$$GSE_Refi_incentive(t) = 100 * \frac{PMT_0(t) - GSE_PMT_1(t)}{PMT_0(t)}. \quad (9)$$

The GSE refinance incentive variable is used in transitions other than current-to-SR. The refinance incentive for a loan refinanced from FHA in the transition current-to-SR is:

$$FHA_Refi_incentive(t) = 100 * \frac{PMT_0(t) - FHA_PMT_1(t)}{PMT_0(t)}. \quad (10)$$

Unemployment Rate

There is ample literature that indicates job loss, or loss of income, is one of the major trigger events for mortgage default. The natural choice of macroeconomic variables to capture this effect is the unemployment rate. However, during the 1994-2008 period, when the U.S. economy grew at a steady rate and only experienced a minor recession, the variation in the unemployment rate was extremely small, which makes it difficult to demonstrate that it is a significant factor. The national unemployment rate in this period was almost always between 4% and 6%. That is part of the reason why previous attempts to use this variable showed it as not statistically significant. After 2008, the unemployment rate rose rapidly, and consequently we have found that this variable is both statistically and economically significant in the borrower’s default behavior.

The 2012 Review introduced two types of unemployment rates: the short-term unemployment rate change, $Delta_UE(t)$, and a relative unemployment rate, $Relative_UE(t)$. The short-term unemployment rate change is measured as the change in the unemployment rate level between

last quarter and the level three quarters ago, which indicates the direction of change in unemployment. The relative unemployment rate is measured as the ratio between the unemployment rate level in last quarter, $UE(t-1)$, and the moving average over the last 10 years, $UE_{10yr_avg}(t)$, which indicates the current inventory of unemployment. For example, although the quarterly change in the unemployment rate did not vary much after year 2008, the relative unemployment rate continued to climb due to the recession. The formulas for computing these two measures are:

$$Delta_UE(t) = UE(t - 1) - UE(t - 3), \quad (11)$$

$$Relative_UE(t) = \frac{UE(t-1)}{UE_{10yr_avg}(t)}. \quad (12)$$

Debt-to-Income (DTI) Ratio

The DTI ratio measures the ratio of monthly debt payment to before-tax total household income at origination. There are two ratios available: the front-end ratio, which counts only the mortgage-related housing cost, i.e., PITI (principal, interest, tax and insurance); and the back-end ratio, which includes payments for all other regular monthly debt, including car loans, student loans, and credit cards. We use the front-end ratio to capture the debt burden effect for the borrower, because it is better documented and measured more accurately than the back-end ratio.

Current Loan-to-Value (CLTV) Ratio

This variable is calculated as the origination Loan-to-Value (OLTV), divided by the appreciation factor since origination (i.e., inflating—or deflating—the denominator, the house price), adjusted for amortization. Empirical results show that the mortgage default rate is very sensitive to the CLTV ratio, when the property value moves into the negative equity range (at a CLTV near to or greater than 100%). This empirical result is consistent with option theory, when the put/default option is in-the-money when the property is “underwater,” and the borrower would have a financial incentive to exercise this option. The CLTV variable is a more direct way to capture the borrower’s incentive to default than is the probability of negative equity variable (PNEQ) used in prior Reviews. However, PNEQ is still included in the ARM current-to-prepay equation. In general, ARM transitions are more difficult to predict than FRM’s.

CLTV was used as a continuous variable for transitions to prepayment and to cure (both self and modifications), but to capture nonlinearities and because of thin data at high CLTVs, we otherwise used splines, and constrained the CLTV function at a fixed level for transitions to default and to claim (all such transitions except for FRM15, FRM SR and ARM SR, where one of the transitions current to default and default to claim was not capped). For example, we applied a piece-wise linear spline function for the default-to-claim transition for FRM30 loans

with knots (the k 's) of 0.6 and 1.0 and constrained the CLTV function at its value at knot 1.0 for CLTVs above 1.0. The spline function with two knots k_1 and k_2 is specified as follows, where $cltv$ is the continuous CLTV variable:

$$cltv1 = \begin{cases} cltv & \text{if } cltv \leq k_1 \\ k_1 & \text{if } cltv > k_1 \end{cases}$$

$$cltv2 = \begin{cases} 0 & \text{if } cltv \leq k_1 \\ cltv - k_1 & \text{if } k_1 < cltv \leq k_2 \\ k_2 - k_1 & \text{if } cltv > k_2 \end{cases}$$

$$cltv3 = \begin{cases} 0 & \text{if } cltv \leq k_2 \\ cltv - k_2 & \text{if } cltv > k_2 \end{cases}$$

Coefficient estimates for each variable are the incremental slopes of the line segments between each knot point. They were estimated for each product and transition type combination, except for the exceptions noted above that use the linear form. The overall generic CLTV function for the 3-cltv segment example is given by:

$$CLTV \text{ Function} = \beta_1 \cdot cltv1 + \beta_2 \cdot cltv2 + \beta_3 \cdot cltv3 \quad (13)$$

This function is estimated as a set of three variables in each binomial equation. For those cases where we capped the effect of CLTV at high levels (above the last knot point), we set the estimate of β_3 to zero.

Loan-to-Value Ratio

The initial LTV is recorded in FHA's data warehouse. For fully underwritten mortgage products and streamline refinance loans with required appraisals these LTV values are used directly to compute the CLTV. Following the approach adopted for the FY 2011 Review, for streamline refinance loans without required appraisals, we have linked the streamline refinance loans with the original fully underwritten FHA mortgage to the same borrower, and used the information from this original loan as the starting point for updating CLTVs. If the previous mortgage was also a streamline refinance mortgage we kept going back until we reached the original fully underwritten mortgage.

Indicator variables were used in transitions: l_{tv100} is unity if the original LTV is greater than 95 percent, and l_{tv95} is unity if the LTV is greater than 90 but less than or equal to 95 percent; otherwise, these variables are zero.

Home Price Volatility

Option theory predicts that the put (default) option value increases when the volatility of the collateral increases, everything else equal. Empirical results show the marginal effect of home price volatility on default behavior is generally positive, which is consistent with option theory. An easier way to interpret this phenomenon is that the home price volatility measures our uncertainty in calculating the updated property value; higher volatility would introduce more error on both positive and negative sides. However, the loss introduced on the negative side is not compensated by the gain on the positive side, due to the asymmetric nature of mortgage credit risk.

The home price volatility is the same as the measurement of parameters “ a ” calculated in the Probability of Negative Equity, which indicates uncertainty with regard to the dispersion of individual house price appreciation rates around the market average, represented by the local-level HPI. The parameter “ a ” is estimated by FHFA when applying the three-stage weighted-repeat-sales methodology advanced by Case-Shiller (1987, 1989). See Appendix C below.

Home Price Appreciation

The home price enters the model via two variables, each of which has a different interpretation. Home price appreciation since origination (at the metro/non-metro area level) determines the CLTV ratio, which is used to measure the current equity in the property. Short-term house price appreciation, which proxies for people’s expectation of future house price movements, is also used. The rationale for this variable is that borrowers make their decisions not only on the realized historical information, but also on their expectation about future house price appreciation. Short-term home price appreciation, $HPA2y(t)$, is calculated as the projected house price index one year ahead, $HPI(t+4)$, divided by historical house price index one year ago, $HPI(t-4)$, measured at both the national level and at the Metropolitan Statistical Area (MSA) level, $HPI(i)$:

$$HPA2Y(t, i) = \frac{HPI(t+4, i)}{HPI(t-4, i)} \quad (14)$$

When historical observations are used to estimate the transition equations, actual four-quarter-ahead observations are used to measure this variable. For simulations along future HPA/interest rate paths, the same measurement is made, using the projected HPAs four-quarters ahead.

The variable $hpa2y_n = \min(0, hpa2y)$. It differentiates the response when the anticipated HPA is negative compared to positive.

Relative Loan Size

This variable is proxied by the mortgage origination amount divided by the average loan origination amount in the same state for the same fiscal year. It replaces the relative house price variable used in previous Reviews. Empirical results show this variable is very significant in prepayment-related termination. This is consistent with option theory, since loans with higher loan size could achieve higher monetary savings, given the same relative mortgage spread. For hypothetical loans originated after FY 2013Q2, we applied relative loan size assumptions consistent with the loans originated during FY 2012Q3 to FY 2013Q2.

Spread at Origination (SATO)

SATO is measured as the spread between the mortgage note rate, C , and the prevailing mortgage rate, R , at the time of origination. It is widely regarded as the lender surcharge for additional borrower risk characteristics, which are not captured by standard underwriting hard data such as FICO score, OLTV, DTI ratio, documentation level, etc. A high SATO loan is generally more risky, compared to a similar loan with a low SATO. Some researchers also argue that a high SATO is an indicator of predatory lending, which also tends to increase credit risk.

$$SATO = C - R. \tag{15}$$

Burnout Factor

A burnout factor is included to identify borrowers who have foregone opportunities to refinance. It is measured as the accumulation of the positive spreads between the coupon rate and new refinance mortgage rate throughout the life of loan. The burnout factor is included to account for individual differences in propensity to prepay, often characterized as unobserved heterogeneity. In addition, unobservable differences in borrower equity at the loan level may give rise to heterogeneity that can impact both prepayment and claim rates. Only the FRM30 equations exhibit this effect.

For 30-year FRMs, we observed that burnout increases the likelihood of default, most likely because the borrowers did not lower their mortgage payments when the current market rate was lower than their contract rate, possibly because they had negative equity. However, after a number of quarters, the effect may be reversed, showing a lower propensity to default, as if their attitude toward not refinancing carries over to a tendency not to default.

When the refinance option is foregone over a long period of time, especially when the magnitude of the quarterly observed spreads are large, it is very likely that the probability of exercising the refinance option would not continue to decrease with an even larger refinance incentive. To capture this feature, we forced the slope of the impact of burnout to zero when it reached a certain level. The 95th percentile of the latest observations on each loan for all loans experiencing burnout is the cut-point, which turns out to be 96.3 percent. Therefore, we are assuming that once a loan has the value of the burnout factor larger than 96.3 percent, increased burnout would not further impact the probabilities of the various transitions anymore.

Credit Burnout

Burnout is a relatively well-understood concept in prepayment modeling. Borrowers who have forgone refinance opportunities in the past are less likely to refinance in the future. Similarly, borrowers who have forgone a default option and showed resilience by making uninterrupted payments in the past are less likely to default in the future. We use the cumulative number of quarters that a property has been “underwater” to proxy this effect.

When the default option has not been exercised for a long period, it is very likely that the probability of exercising the default option would not continue to decrease in the future. To capture this feature, we force the slope of the impact of credit burnout to zero when it reaches a certain level. The 95th percentile of the latest observations on each loan for all loans experiencing credit burnout is the cut-point, which turns out to be 14 quarters. That is, effects beyond this point were not observed sufficiently to rely on any non-zero estimate we may have derived. Therefore, we assumed that once a loan has been underwater for more than 14 quarters, credit burnout would no longer impact the transition probabilities.

Property Type

We include property type (number of units) into our transition model framework. Multi-unit single-family properties (2, 3, 4 units) are generally at least partially rental properties. The volatility of the rental income, combined with idiosyncratic risk of the properties, tends to increase the default risk for these loans and reduce the prepayment propensity.

Specification of Piece-Wise Linear Age Functions

Exhibit A-7 lists the series of piece-wise linear age functions that were used for each of the loan status transitions for each of the six different mortgage product types. For example, we used a piece-wise linear age function for current-to-streamline refinance transitions of FRM30 loans with knots (the k’s) at ages 2, 5 and 10 quarters by generating 4 new age variables age1 to age4 defined as follows:

$$\begin{aligned}
 \text{age1} &= \begin{cases} \text{AGE} & \text{if AGE} \leq k_1 \\ k_1 & \text{if AGE} > k_1 \end{cases} \\
 \text{age2} &= \begin{cases} 0 & \text{if AGE} \leq k_1 \\ \text{AGE} - k_1 & \text{if } k_1 < \text{AGE} \leq k_2 \\ k_2 - k_1 & \text{if AGE} > k_2 \end{cases} \\
 \text{age3} &= \begin{cases} 0 & \text{if AGE} \leq k_2 \\ \text{AGE} - k_2 & \text{if } k_2 < \text{AGE} \leq k_3 \\ k_3 - k_2 & \text{if AGE} > k_3 \end{cases} \\
 \text{age4} &= \begin{cases} 0 & \text{if AGE} \leq k_3 \\ \text{AGE} - k_3 & \text{if AGE} > k_3 \end{cases}
 \end{aligned} \tag{16}$$

Coefficient estimates for each variable are the incremental slopes of the line segments between each knot point and for the last open-ended segment. They were estimated for each product and transition type combination and reported in Exhibit A-5. The overall generic AGE function for the 4-age segment example described above is given by:

$$\text{Age Function} = \beta_1 \cdot \text{age1} + \beta_2 \cdot \text{age2} + \beta_3 \cdot \text{age3} + \beta_4 \cdot \text{age4} \tag{17}$$

Age functions with fewer numbers of segments were developed in a similar manner. The number of segments and the selection of the knot points were determined by testing alternative specifications and assessing the reasonableness of the resulting functions. For some products and transition types the age functions were omitted altogether due to the instability or statistical insignificance of the estimated parameters.

Specification for Default Durations

We changed the specification for default durations last year and maintained the same procedure this year. Until last year, the default durations interacted with the judicial state indicator in a categorical format. The reason for specifying the variable in a categorical format is that we needed to limit the dimensions of the matrix of transition probabilities. Last year we changed the forecasting methodology to a dynamic simulation, as described in Appendix G, which enabled us to increase the dimension of default durations, which we made into a continuous variable and put into a spline form.

Judicial State Indicators

As mentioned above, judicial state indicators are separated from the default durations as we did last year. If the collateral property is in a judicial state, the indicator is equal to 1, otherwise it equals zero.

Seasonality Indicators

The season of an event observation quarter is defined as the season of the year corresponding to the calendar quarter, where season 1 = Winter (January, February, March), 2 = Spring (April, May, June), 3 = Summer (July, August, September), and 4 = Fall (October, November, December). All categorical (0-1 dummy) variables take on the value of 1 for the specified quarter; and one of the categories is omitted as the reference category.

ARM Payment Shock

This variable is an approximation to the call option value of the quarterly mortgage payment, PMT, calculated by amortization schedule and driven by the difference between the ARM coupon rates, $C(t)$ (that are updated over the life of mortgage as described below) and initial contract rates, $C(0)$:

$$pmt_shock(t) = \left\{ 100 * \frac{PMT(t) - PMT(0)}{PMT(0)} \right\}. \quad (18)$$

This variable is typically reserved to predict defaults, but over most of the estimation period, rates have fallen, and it is not statistically significant in the equation. However, we found it useful for the ARM prepayment transition, and it was used along with the above mortgage premium variable.

ARM Coupon Rate Dynamics

To estimate the current financial value of the prepayment option for ARM loans, and to compute amortization rates that vary over time, we tracked the path of the coupon rate over the active life of individual ARM loans. The coupon rate resets periodically to a new level that depends on the underlying index, plus a fixed margin, subject to periodic and lifetime caps and floors that specify the maximum and minimum amounts by which the coupon can change on each adjustment date and over the life of the loan. Accordingly, the ARM coupon rate at time t , $C(t)$, was computed as follows:

$$C(t) = \max\{ \min[\text{Index}(t - S) + \text{Margin}, \\ C(t - 1) + A(t) \cdot \text{Period_UpCap}, C(0) + \text{Life_UpCap}], \\ C(t - 1) - A(t) \cdot \text{Period_DownCap}(t), \max(C(0) - \text{Life_DownCap}, \text{Life_Min}) \} \quad (19)$$

where $\text{Index}(t)$ is the underlying rate index value at time t , S is the “look back” period, and Margin is the amount added to $\text{Index}(t - S)$ to obtain the “fully-indexed” coupon rate. The periodic adjustment caps are given by Period_UpCap and Period_DownCap , and are multiplied by dummy variable $A(t)$ which equals zero except during scheduled adjustment periods. Maximum lifetime adjustments are determined by Life_UpCap and Life_DownCap , and Life_Min is the overall minimum lifetime rate level. Any initial discounts in ARM coupon rates are reflected in the original interest rate represented by $C(0)$ in equation (19).

Yield Curve Slope

Expectations about future interest rates and differences in short-term and long-term borrowing rates associated with the slope of the Treasury yield curve influence the choice between ARM and FRM loans and the timing of refinancing. We used the spread of the 10-year Constant Maturity Treasury (CMT) yield over the 1-year CMT yield to measure the slope of the Treasury yield curve.

Exposure Year/Quarter FRM Rate

A variable measuring the market average FRM mortgage rate is included to distinguish high-rate and low-rate market environments. This variable was entered as a continuous linear variable in the ARM equations.

Source of Downpayment Assistance

As documented in the 2006 and 2007 Reviews, the FHA single-family program experienced a significant increase in the use of downpayment assistance from relatives, non-profit organizations, and government programs. Following the approach first applied in the 2006 Review, we have included a series of indicators to control for the use of different types of downpayment assistance by FHA borrowers. Loans to borrowers utilizing downpayment assistance from non-profit organizations have experienced significantly higher claim rates than otherwise comparable loans without this type of downpayment assistance. Although this particular form of downpayment assistance is now prohibited, it is still necessary to control for their impact on historical and future loan performance for those loans that received such assistance. An omitted category does not apply here, because not all borrowers use downpayment assistance.

Borrower Credit Scores

Borrower credit scores at the loan level were first included in the models estimated for the 2007 Review and continue to be an important predictor of claim and prepayment behavior. FHA has relatively complete data on borrower FICO scores for loans originated since May 2004. In addition, FHA retroactively obtained borrower credit history information for selected samples of FHA loan applications submitted as far back as FY 1992. These data provide an additional source of loan-level information on borrower FICO scores that are used for estimation. Historical FICO score data was collected for HUD by Unicon Corporation for FHA applications submitted during FY 1992, FY 1994, and FY 1996. FICO scores of the primary borrower and up to two co-applicants were collected from a single credit data repository for a random sample of approximately 20 percent of loan applications. Since the estimation dataset for the transition equations starts in FY 1996, only the latter sample is relevant for this Review.

A second set of sample data was collected for loan applications over the period from FY 1997 to FY 2001. FICO scores for up to three co-applicants were collected from up to two credit data repositories for about 20 percent of the loans in each year, with over-sampling of loans defaulted by April 2003. A third and final set of data, similar to the second set, was collected for FY 2002 to FY 2005 applications, with over-sampling of loans defaulted by February 2005. The over-sampling of historical borrower credit scores for default outcomes introduces issues of choice-based sampling. These issues are addressed in a separate section below.

These three sets of FICO data represent the most reliable sources of borrower credit history information available for historical FHA-endorsed loans prior to FY 2005. Following the methodology adopted by Freddie Mac and Fannie Mae, the FICO score of each individual borrower or co-borrower, respectively, is the median (of three) or minimum (of two) scores when scores are provided by multiple credit data repositories. The final FICO score assigned to a loan is the simple average of these individual FICO scores for the borrower and up to four co-borrowers.

Additional indicator variables were specified to represent two particular forms of missing data on FICO scores. The categorical outcome 000 was defined corresponding to loans in the Unicon sample known to have been submitted for scoring to one more credit data repository, but for which the borrower credit history was insufficient to generate a FICO score. The categorical outcome 999 was defined corresponding to loans originated prior to FY 2005 for which no attempt was made to obtain a FICO score, due either to exclusion from the Unicon sample or because they were originated prior to the availability of FHA FICO scores.

Through the process of linking streamline refinance loans to the original fully underwritten FHA mortgages to the same borrowers, we developed a parallel set of FICO score indicators for

streamline refinance loans and included these as explanatory variables when estimating the transition probability models for these products.

Finally, an indicator was defined to distinguish loans with FICO scores obtained through the normal FHA loan approval process from loans for which FICO scores were obtained from the retrospective historical sampling procedure conducted by Unicon Corporation. This variable was included to control for the potential effect of choice-based sampling due to the oversampling of defaulted loans in the Unicon project.

Choice-Based Sampling of Historical FICO Scores and Random Sampling of FHA Loans

As described in Section I of this Appendix, random samples of less than 100 percent of the available data were used for the estimation of the loan status transition models for some loan products. In prior years, a stratified random sampling scheme was applied to assure adequate representation of loans with historical FICO score data. Starting from the 2012 Review, we have elected to utilize simple random sampling for those products utilizing less than 100 percent samples. The number of years of relatively complete credit score data from FHA now includes FY 2004 to FY 2013, and since estimation is now based on data for loans endorsed during FY 1996 to FY 2013, a greater reliance is placed on FHA's own credit score information. In recognition of the potential impact of choice-based sampling of the Unicon-supplied credit scores, we continue to include the indicator of whether the loan was included in the Unicon loan subsample.

FHA Score Indicator

As mentioned above, the borrower's FICO scores could be collected directly by FHA or through the choice-based sample collection by Unicon. An FHA score indicator is included to capture the difference of the source of borrower's credit scores. If the score was directly collected through FHA's underwriting requirement, the FHA Score Indicator equals to one, otherwise, the variable is assigned to equal to zero.

Variables for Streamline Refinance Mortgages

The current Review follows the same logic used in the 2012 Review that linked streamlined refinance mortgages to their original fully underwritten FHA loans previously issued to the same borrower. Many FHA borrowers receive multiple streamline refinances over time, so the process of linking any given streamline refinance mortgage with its original ancestor loan sometimes requires establishing prior linkages through a sequence of FHA loans. We were able to identify the original fully underwritten FHA mortgage for about 98 percent of all streamline refinance mortgages originated and endorsed for FHA insurance since FY 1990.

For the streamline refinance mortgages that were not traceable back to original fully underwritten FHA mortgage, we imputed the loan attributes of original fully underwritten FHA mortgage with median values of ones that do trace back to original fully underwritten FHA mortgage.

The main benefit of linking streamline refinance mortgages with their original fully underwritten loans is that it enables us to improve the estimation of the current LTVs and probabilities of negative equity for the subsequent streamline refinance mortgages. The process of updating current LTVs begins at loan origination and proceeds period-by-period over the life of the loan. In the case of the streamline refinance mortgage, we obtained the original LTV and property values and updated them from that point forward, as if the current streamline refinance was a continuation of the original mortgage (for this purpose only, not for amortization and other dynamic processes specific to the current loan). We only applied this process to streamline refinance mortgages without required appraisals. In those cases where appraisals were required, we used the information from the appraisals to compute the current LTVs for the streamline mortgage; and we used the variable *appraisal_req*, which is unity when an appraisal was required for the SR loan, zero when it was not required. This variable showed that transition probabilities to default, to claim, and from current to SR are less when an appraisal is required; and the other transition probabilities are increased, other things held constant.

We were also able to assign indicators of original LTV, relative loan size, and downpayment assistance type to current streamline mortgages based on the original fully underwritten mortgage and to include these values for the respective variables in the models for streamline refinance mortgage products.

Finally, we developed indicators of the loan product type of the prior mortgages to include as an explanatory variable in the status transition models for streamline refinance loans. The baseline category is 30-year fixed-rate mortgages.

IV. Logistic Model Estimation Results

Exhibit A-5 (parts A-5.1 to A-5.6) present the coefficient estimates for the binomial logistic models for all of the product and transition type combinations of the model. We included the explanatory variable descriptions and value definitions directly alongside the parameter estimates to facilitate comparison of the models.

Variable		Status Transition (from to)															
Description	Name	Values	Current Default	Current CurrentX	Current Prepay	Current SR	Default Claim	Default Prepay	Default cure_m	Default cure_s							
Mortgage age function	age1	Spline function knot values shown next to the corresponding coefficient estimates	1.3940	1.6722	0.6189	0.9837	0.1492	-0.0443	0.2972	0.0327							
	age2		0.1556	0.1387	10	-0.0131	0.0197	-0.0443	0.0061	0.0012							
	age3		-0.0055	-0.0332	20	-0.1164											
	age4				50	-0.0661											
	age5				>50	-0.0348											
Burnout factor. Cumulative amount of quarterly positive refinance incentives	burnout1	linear function	0.0052	0.0125	-0.0068	-0.0038											
	burnout2	Spline function	-0.0010														
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	linear function	0.0086			0.0287											
	c_burnout2	Spline function	-0.0205														
Credit score	credit_score1	linear function	0.0025	0.0041	0.0011	0.0025	0.0022	0.0012	0.0002	0.0008							
	credit_score2	Spline function	-0.0091	-0.0161	0.0042	0.0034	0.0040		-0.0028	-0.0021							
	credit_score3		-0.0126		0.0021												
Missing credit score	credit_score_000	X=0/1	-0.1422	-0.4278	0.0710	-0.1743	0.3053	0.1407	-0.1673	-0.1160							
	credit_score_999	X=0/1	-0.5929	-0.4410	0.2283	0.2448	-0.6975	0.3516	-0.0573	0.0849							
Unemployment rate change in last two quarters	delta_ue	linear function	0.0991			0.2180											
	delta_ue1	Spline function	0.1775														
Downpayment assistant types	dpa_0wt	X=0/1	0.1823	0.2896	-0.0729	-0.4643	0.0025	-0.2186	-0.0830	0.0285							
	dpa_0mpr	X=0/1	0.3222	0.3829	-0.1334	0.1548	0.2611	-0.3527	0.1110	-0.1138							
	dpa_relative	X=0/1	0.1198	0.1628	0.0547	-0.0236											
Missing front-end ratio	dfr000	X=0/1	-0.0455	-0.0859	-0.0222	-0.1618				-0.0295							
	dfr30	X=0/1	0.0902														
Non-First time buyer and Front-end ratio>30	dt30_fhb_Y	X=0/1	-0.0464														
	dt30_fhb_Y	X=0/1															
Duration of default episodes	dur_def_episode_1	Spline function					0.0532	-0.0954	0.2790	-0.1716							
	dur_def_episode_2					2	0.2969	0.0811	-0.1797	0.0367							
	dur_def_episode_3					4.5	-0.0629	0.0000	-0.1056	0.0000							
	dur_def_episode_4					12	0.0000	0.0000	0.0000	0.0000							
Indicator of duration of default episodes > 20	dur_def_ept_dum	X=0/1					0.1436										
	fha_score	X=0/1	-0.2723		-0.6804	0.2364	-0.7843		0.2895	0.0465							
FHA credit score indicator	fst_tm_by	X=0/1			-0.0941												
	hpa2y	linear function		0.0051					-0.0044								
House price appreciation local level	hpa2y_n	linear function	-0.0101		0.0152				-0.0211	0.0083							
	hpa2y_wsa	linear function	-0.0043			0.0329		0.0323	-0.0211								
Judicial state	judicial	X=0/1					-0.2471	-0.2017	-0.1948	-0.1544							
	lv_units_2	X=0/1	0.0627	-0.2338	-0.0658	-0.3516	-0.0029	0.1679	-0.3720								
Number of living units	lv_units_34	X=0/1	0.0006		-0.1021	-0.7004		0.1455	-0.6998								
	loansize	linear function								-0.0011							
Relative loan size	loansize1	Spline function		0.0042	0.0118	0.0280		-0.0068	0.0049								
	loansize2			-0.0015	0.0052	0.0090		0.0085	0.0000								
	loansize3				0.0015	0.0030		-0.0003	0.0000								
	loansize4							0.0000	0.0000								
LTV	lv100	X=0/1	0.0051		0.3335	0.0037	0.2109	0.5977	0.0201	0.0755							
	lv95	X=0/1	0.0701		0.2121	0.0500	0.1848	0.4319	-0.0183	0.0018							
Current LTV	lv_current	linear function							-0.6656								
	lv_current2	Spline function	1	1.3717	-3.1116	1.3033	6.6104	0.6	-6.4412								
	lv_current3		1.3	0.9617	-5.4360	-1.2184	1	2.2687	-9.6268								
	lv_current4		1.8	0.8931		0.0000	>1.0	0.0000									

Exhibit A-7.2 Product 2 (FRM15) Binomial Logit Model Coefficient Estimates												
Variable	Name	Values	Status Transition (from_to)									
			Current_Default	Current_CurrentX	Current_Prepay	Current_SR	Default_Claim	Default_Prepay	Default_curr_m	Default_curr_s		
Mortgage age function	age1	Spline function knot values shown next to the corresponding coefficient estimates	2 1.3812	2 1.8346	4 0.5272	2 1.2112	8 0.1970	8 -0.0135	6 0.3534	8 0.0272		
	age2		6 0.1658	10 0.0718	10 0.0699	5 0.0671	8 0.0080	20 -0.0722	6 -0.0038	8 -0.0158		
	age3		12 -0.0146	>10 -0.0273	20 -0.0605	10 -0.1370	>8 -0.0010	>6 -0.0428				
	age4		>12 0.0183	>20 0.0158		>10 -0.1035						
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	Spline function	6 -0.0354									
	c_burnout2	Spline function	>6 -0.0288									
Credit score	credit_score1	linear function	600 -0.0041	-0.0129	0.0013	0.0020	0.0016	0.0003	-0.0010	-0.0010		
	credit_score2	Spline function	>600 -0.0136									
Missing credit score	credit_score_000	X=0/1	-0.4617	-0.6411	0.0965	-0.4662	0.0492	0.4919	-0.1777	0.0868		
	credit_score_999	X=0/1	-0.5990	-0.3875	0.1771	0.3537	-0.5638	0.5035	-0.2130	0.1476		
Unemployment rate change in last two quarters	delta_ue	linear function	0.2251			0.1184						
	dpa_govt	X=0/1					0.1421	-0.4911	0.2425	-0.1719		
Downpayment assistant types	dpa_nouprof	X=0/1	0.6309	0.7100	-0.2475	1.0698	0.2215	-0.5534	-0.0259	-0.1838		
	dpa_relative	X=0/1	0.2210	0.4542	0.0526							
Missing front-end ratio	dt000	X=0/1	-0.2077	-0.3825	-0.1155	-0.6415				0.0062		
	dur_def_episode_1	Spline function					5 0.2386	12 -0.1012	3 0.2739	10 -0.1588		
Duration of default episodes	dur_def_episode_2	Spline function					20 -0.0578	20 0.0515	12 -0.1532	20 0.0506		
	dur_def_episode_3	Spline function					>20 0.0000	>20 0.0000	>12 0.0000	>20 0.0000		
Indicator of duration of default episodes > 20	dur_def_epd_dum	X=0/1					1.0415					
	fha_score	X=0/1	0.0390		-0.2228	1.3704	-0.6972					
House price appreciation local level	hpa2y	linear function		0.0032					0.0044			
	hpa2y_n	linear function	-0.0077						-0.0233			
House price appreciation national level	hpa2y_usa	linear function			0.0227	0.0454			0.0385			
	judicial	X=0/1					-0.4267	-0.1458	-0.1453	-0.1688		
Number of living units	liv_units_2	X=0/1			-0.0887	-0.2118			0.0996			
	liv_units_34	X=0/1			-0.1580	-0.3642			0.2693			
Relative loan size	loansize1	linear function	-0.0007		0.0054		-0.0041		0.0023			
	loansize2	Spline function				100 0.0309						
LTV	lrv100	X=0/1	0.0626		0.0967	-0.0045	0.6058		-0.0294			
	lrv95	X=0/1	0.0639		0.0717	-0.0056	0.3962		-0.0799			
Current LTV	lrv_current1	linear function							0.4312			
	lrv_current2	Spline function	1 1.9519		0.4		2.5034		-0.2019			
	lrv_current3	Spline function	1.2 0.8066		0.9		>1.2 0.0000		-6.0823			
			>1.2 0.0000		>0.9							

Variable		Status Transition (from, to)									
Description	Name	Values	Current_Default	Current_CurrentX	Current_Prepay	Current_SR	Default_Chain	Default_Prepay	Default_curr_m	Default_curr_s	
Mortgage age function	age	linear function	2	1.7763	4	1.1732	4	0.1547	-0.0047	-0.0019	
	age1	Spline function knot values shown next to the corresponding coefficient estimates	6	0.1451	10	0.2402	12	0.0869			
	age2		20	-0.0024	20	-0.1187	>12	0.0233			
	age3		>20	0.0106	>12	-0.1335					
age4											
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	Spline function	6	0.0138							
	c_burnout2		>6	-0.0415							
Credit score	credit_score	linear function	600	-0.0110	0.0021	0.0008	0.0025	0.0012	-0.0015	-0.0011	
	credit_score1	Spline function	>600	-0.0095							
Missing credit score	credit_score_000	X=0/1		-0.1810	0.0275	-0.0636	0.3435	0.0386	-0.1523	-0.0816	
	credit_score_999	X=0/1		-0.5046	0.1824	0.1483	-0.7476	0.2724	0.0173	0.1316	
Unemployment rate change in last two quarters	dela_ue	linear function	0.0605			0.0527					
	dpa_govt	X=0/1	0.1945	0.3277	-0.1126	-0.0709	0.1890	-0.2859	-0.0002	-0.0269	
Downpayment assistant types	dpa_nonprof	X=0/1	0.2392	0.2984	-0.0581	0.0895	0.2581	-0.2637	0.1548	-0.0408	
	dpa_relative	X=0/1	0.1337	0.1524	-0.0032	-0.1538					
Missing front-end ratio	dt000	X=0/1	0.0700	-0.0099	-0.1172	-0.0230				-0.0260	
	dur_def_episode_1	Spline function					5	0.1838	3	0.3480	
Duration of default episodes	dur_def_episode_2					20	-0.0345	20	0.0772	12	
	dur_def_episode_3					>20	0.0000	>20	0.0000	>20	
Indicator of duration of default episodes > 20	dur_def_epd_dum	X=0/1					0.3337				
	ev_rate	linear function	0.1063		-0.1817	-0.1590					
FHA credit score indicator	fla_score	X=0/1	-0.1460	-0.4082	-0.4082	-0.3789	-0.6231		0.2139	-0.0531	
	frst_lm_by	X=0/1			-0.0924						
House price appreciation local level	hpa2y	linear function		0.0075							
	hpa2y_n	linear function									
	hpa2y_n1	Spline function	-20	0.0056					-0.0070		
hpa2y_n2		>20	-0.0148								
House price appreciation national level	hpa2y_usa	linear function			0.0120				-0.0336	0.0109	
	judicial	X=0/1									
Number of living units	liv_units_2	X=0/1									
	liv_units_34	X=0/1									
	liv_units_34	X=0/1	0.3276								
Relative loan size	loansize	linear function									
	loansize1	Spline function	120	-0.0023	130	0.0070	100	0.0184			
loansize2		>120	0.0022	>130	0.0001	>100	0.0018				
LTV	ltv100	X=0/1	0.0829	0.2439	0.1703	0.2881	0.1429	0.2979	0.0232	-0.0301	
	ltv95	X=0/1	0.0734	0.1703	0.1703	0.2579	0.1459	0.2304	-0.0403	-0.0092	
Current LTV	ltv_current	linear function									
	ltv_current1	Spline function	1	1.5153	0.6	-3.1930	0.8	4.3705	0.6	-5.7372	
	ltv_current2		1.4	0.7972	>0.6	-4.6408	1	0.8194	>0.6	-9.4757	
ltv_current3		>1.4	1.2252			>1.0	0.0000				

Exhibit A-7.4 Product 4 (FRM30 SR) Binomial Logit Model Coefficient Estimates

Description	Variable		Status Transition (from to)											
	Name	Values	Current_Default	Current_CurrentX	Current_Prepay	Current_SR	Default_Claim	Default_Prevay	Default_cure_m	Default_cure_s				
Mortgage age function	age	linear function	2	1.7668	2	1.0531	0.9569	0.0700	6	0.2670	-0.0654			
	age1	Spline function knot values shown next to the corresponding coefficient estimates	5	0.1692	6	0.1241	-0.1033	0.0226	10	0.0213				
	age2		10	-0.0096	18	-0.0204	-0.0146		>10	0.0041				
	age3		50	-0.0053	36	-0.0649								
	age4		>50	0.0000	>36	-0.0394								
age5			-0.0903	0.1109	0.2358	-0.6034	-0.1890	0.4585	-0.9400	0.0535				
Loan with appraisal value	appraisal_req	X=0/1												
Burnout factor: Cumulative amount of quarterly positive refinancing incentives	burnout	linear function		0.0249		-0.0004								
Credit burnout factor: Prior cumulative number of quarters default option is underwater	c_burnout1	Spline function	6	-0.0081										
	c_burnout2		>6	-0.0137										
Credit score	credit_score	linear function		-0.0057		0.0015	0.0021	0.0035		-0.0020	-0.0017			
Missing credit score	credit_score_000			-0.0783		0.0217	-0.4653	0.2646		-0.0145	0.1339			
No credit score returned	credit_score_999			-0.2034		0.2454	0.2811	-0.5785		-0.0016	0.0502			
Unemployment rate change in last two quarters	delta_ue	linear function					0.2007							
Downpayment assistant types	dpa_govt	X=0/1		0.3046		-0.0025	-0.0221	0.0711		0.0809	-0.0083			
	dpa_nonprof	X=0/1		0.3179		0.0246	0.0391	0.1468		0.0793	-0.0604			
	dpa_relative	X=0/1		0.2487		0.1752	-0.0321							
Missing front-end ratio	dt000	X=0/1		0.1270		-0.0816	-0.4185				-0.0559			
Duration of default episodes	dur_def_episode_1	Spline function							12	-0.0935	10			
	dur_def_episode_2								20	0.0705	20			
	dur_def_episode_3								>20	0.0000	>20			
	dur_def_episode_4								0.0000		0.0000			
FHA credit score indicator	fha_score	X=0/1		0.0117		-0.4085	0.6318	-0.7981		0.2568	-0.1419			
House price appreciation local level	hpa2y	linear function												
	hpa2y_n	linear function		0.0017						-0.0079				
	hpa2y_n1	Spline function	<=-20											
	hpa2y_n2		>20	-0.0243										
House price appreciation national level	hpa2y_usa	linear function					0.0506			-0.0172	0.0094			
Judicial state	judicial	X=0/1												
Number of living units	liv_units_2	X=0/1				-0.1353	-0.2679			-0.4129				
	liv_units_34	X=0/1				-0.3119	-0.3123			-0.6286				
Relative loan size	loansize	linear function								0.0031	-0.0003			
	loansize1	Spline function	60	0.0113	120	0.0161	0.0454	-0.0036						
	loansize2		>120	0.0040	150	0.0070	0.0000							
	loansize3		>150	0.0000										
	loansize4			0.1975	0.0169	0.0519	0.1483	0.1871	0.0243	0.0243	0.0240			
LTV	lrv00	X=0/1		0.0316		0.0316	0.0519	0.1412	0.0215	0.0215	-0.0171			
	lrv95	linear function												
Current LTV	lrv_current	Spline function	1.2	1.7806	0.6	-2.1677	3.6947	5.2067	0.8	0.8	0.8			
	lrv_current1		>1.2	0.9037	>0.6	-5.1655	1.2	0.5374	1	0.5374	1			
	lrv_current2						>1.0	0.0000	>1.0	0.0000	0.0000			
	lrv_current3										-1.5152			

Variable		Status Transition (from, to)																									
		Current_Default		Current_CurrentX		Current_Propay		Current_SR		Default_Claim		Default_Propay		Default_curr_e_m		Default_curr_e_s											
Description	Name	Values	2	6	20	>20	0.2932	-0.0281	0.0961	-0.0496	0.0069	>10	1.4618	0.0493	-0.1383	-0.0870	0.2674	0.0478	-0.0365	6	>6	6	>6	0.2103	-0.0107	-0.0360	
Mortgage age function	age1 age2 age3 age4	linear function Spline function (knot values shown next to the corresponding coefficient estimates)	1.1591 0.1012 -0.0017 0.0050	0.2932 -0.0281	0.0961 -0.0496	0.0069	1.4618 0.0493 -0.1383 -0.0870	0.2674 0.0478	-0.0365	6 >6	0.2103 -0.0107	-0.0360															
Loan with appraisal value	appraisal_req	X=0/1	-0.8808	0.0633			0.3055						-4.5538				-4.3375			0.6473				0.1340			0.2713
Credit score	c_burnout1 c_burnout2 credit_score1 credit_score2	Spline function linear function Spline function	0.0309 -0.0635 -0.0032 -0.0114	-0.0125	0.0001		0.0021						0.0021				0.0049			0.0027				-0.0027			-0.0010
Missing credit score	credit_score_000	X=0/1	-0.2504	-0.3450			-0.4359						-1.7117				-0.0203			-0.7621				0.1587			-0.1861
No credit score returned	credit_score_999	X=0/1	-0.5157	-0.6652			0.0546						0.3303				-0.0594			0.1307				-0.0596			-0.0363
Unemployment rate change in last two quarters	delta_ue	linear function	0.1644									-0.1191															
Downpayment assistant types	dpa_govt dpa_nonprof dpa_relative	X=0/1 X=0/1 X=0/1	0.2380 0.2696 0.1699	0.1658 0.0784 0.3474			0.0161 0.1510 0.1747						0.4359 0.0601 0.0899				0.6353 0.7103			-0.3102 -0.2992			0.3144 0.0228			-0.0360 -0.2761	
Missing front-end ratio	dl000	X=0/1	0.1938	0.1704			-0.1060						-0.4339														0.0983
Duration of default episodes	dur_def_episode_1 dur_def_episode_2 dur_def_episode_3	Spline function																									
FHA credit score indicator	fha_score	X=0/1	0.0532				0.0078						2.0974														
House price appreciation local level	hpa2y hpa2y_n	linear function linear function		0.0059																				0.0042			
House price appreciation national level	hpa2y_usa	linear function					0.0256						0.0640											-0.0201			0.0096
Judicial state	judicial	X=0/1															0.0440							-0.1323			
Number of living units	liv_units_2 liv_units_34	X=0/1 X=0/1					-0.0883 -0.2970						-4.3037 -0.6071											-0.2125 -1.1100			
Relative loan size	loansize	linear function	0.0005				0.0046						0.0119				-0.0076						0.0027				0.0003
LTV	lrv100 lrv95	X=0/1 X=0/1	0.0010 0.0882				0.1158 0.0540						0.0654 -0.0426				0.3093 0.3170						0.1099 0.1304			0.0334 -0.0186	
Current LTV	lrv_current1 lrv_current2 lrv_current3	linear function Spline function					0.8 >0.8										5.9685 0.0000							-0.4679			-2.0624

Variable		Status Transition (from to)																
		Current	Default	Current	Current	Prepay	Current	SR	Claim	Prepay	Default	Current	Definit	Definit				
Description	Name	Values	2	1.3505	2	1.9348	6	0.2094	2	1.1794	8	0.1251	6	-0.0593	5	0.2494	5	-0.0032
Mortgage age function	age	linear function	6	0.2094	2	1.9348	6	0.2094	2	1.1794	8	0.1251	6	-0.0593	5	0.2494	5	-0.0032
	age1	Spline function knot values shown next to the corresponding coefficient estimates	12	-0.0589	5	-0.0405	12	-0.0589	5	-0.0405	>8	0.0232	>6	-0.0645	>5	-0.0033		
	age2		>12	-0.0556	10	-0.2008	>12	-0.0556	10	-0.2008								
	age3		>8	-0.0418	>10	-0.0921	>8	-0.0418	>10	-0.0921								
	age4		>20	0.0045			>20	0.0045										
Loan with appraisal value	appraisal_req	X=0/1	6	0.2000			6	0.2000		-0.3420		-0.2764		0.2379		0.0159		0.0726
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	Spline function	>6	-0.0260			>6	-0.0260										
	c_burnout2		600	-0.0025			600	-0.0025		0.0002		0.0035		0.0002		-0.0016		-0.0014
Credit score	credit_score	linear function	>600	-0.0076			>600	-0.0076										
	credit_score1	Spline function																
	credit_score2																	
Missing credit score	credit_score_000	X=0/1		-0.4300				-0.4300		-0.0773		0.0944		-0.1394		0.0246		0.3629
No credit score returned	credit_score_999	X=0/1		-0.3921				-0.3921		0.0691		-0.3822		0.2061		-0.0848		0.1969
Unemployment rate change in last two quarters	delta_ue	linear function		0.1046				0.1046		0.0352								
Downpayment assistant types	dpa_govt	X=0/1		0.1738				0.1738		0.1323		0.2219		0.1569		0.1466		-0.0476
	dpa_nonprof	X=0/1		0.2287				0.2287		0.1277		0.2015		-0.1930		0.0661		-0.0814
	dpa_relative	X=0/1		0.0745				0.0745		-0.1631								
Missing front-end ratio	dfi000	X=0/1		0.2021				0.2021		0.3222								-0.0787
Duration of default episodes	dur_def_episode_1	Spline function									4	0.2299	12	-0.0898	3	0.2291	10	-0.1509
	dur_def_episode_2										20	-0.0173	20	0.0849	20	-0.1379	20	0.0656
	dur_def_episode_3										>20	0.0000	>20	0.0000	>20	0.0000	>20	0.0000
Current mortgage rate level	ev_rate	linear function						-0.0325		0.0544								
FHA credit score indicator	fha_score	X=0/1		0.2161				-0.1507		-0.2224		-0.4191						-0.1651
House price appreciation local level	hpa2y	linear function		0.0049				0.0049								-0.0003		
	hpa2y_n	linear function		-0.0136				-0.0136										
House price appreciation national level	hpa2y_usa	linear function						0.0231						0.0428		-0.0181		0.0096
Judicial state	judicial	X=0/1										-0.3308		-0.1001		-0.1765		-0.2056
Number of living units	liv_units_2	X=0/1						-0.1280		-0.1195				0.1967		-0.6471		
	liv_units_34	X=0/1						-0.4259		-0.0721				-0.3289		-0.3919		
Relative loan size	loansize	linear function		0.0005				0.0087		0.0153		-0.0010		0.0060		0.0023		0.0000
	loansize1	Spline function																
	loansize2																	
LTV	lvt00	X=0/1		0.0531				0.1171		0.2089		-0.0046		0.0202		-0.0022		0.0154
	lvt95	X=0/1		0.0586				-0.0050		0.1772		0.0194		0.0553		0.0171		-0.0021
Current LTV	lvt_current	linear function																
	lvt_current1	Spline function	1	2.0468				-1.9410			0.9	4.1974		-8.4471		-0.8248		-1.7486
	lvt_current2		1.2	1.7707				-5.6657			>0.9	0.0000						
	lvt_current3		>1.2	0.8184														

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Appendix B
Cash Flow Analysis

Appendix B: Cash Flow Analysis

I. Introduction

The calculation of the economic value of the Fund involves the estimation of the present value of future cash flows generated by the existing portfolio and future books of business. The analysis requires the projection of future prepayment and claim incidence and severity and cash flow items associated with each type of outcome. This appendix describes the components of these cash flow calculations.

The evaluation of the Fund's economic value at a point in time (e.g., end-of-year FY 2014) requires incorporating the value of net assets plus the expected present value of future cash flows. The latter comprises future revenue and expenses. Similarly, the evaluation of the Fund's economic value in future years (FY 2015 through FY 2021) requires the same type of calculation but also requires specification of the size and composition of the future book of endorsements for the relevant years.

In order to analyze future changes in the Fund's economic value, our model incorporates projections of loan performance and information about the existing portfolio composition to project the Fund's various cash flow sources. The actuarial model uses projections from econometric models as discussed in Appendices A (transitions), E (loss rates), F (future volume projections) and G (future economic projections and simulation methodology). We estimated econometric models for conditional transition probabilities for individual loans depending on the loan type, origination year, age, interest rate, loan purpose, initial and current LTV ratio, credit score, refinancing incentive, relative loan size, probability of negative equity, loan term, interest rate and credit burnouts, and other characteristics. The models also used data on serious delinquency status and default history. Using detailed loan-level characteristics, we estimated the various transition probabilities and then generated respective cash flows for individual loans (Appendix A).

We estimated loss severity rates based on an econometric model that predicts future loss severity rates (Appendix E). The loss rate model distinguishes between foreclosure and pre-foreclosure sales. We estimated future FHA mortgage volumes for purchase, refinance and streamline refinance mortgages that vary with alternative house price, unemployment rate and interest rate paths (Appendices F and G).

Based on the mortgage termination rates projected by the econometric models, individual components of cash flows are projected into the future. These cash flows are discounted to the present time based on the OMB discount factors. The relevant cash flow components are itemized in Exhibit B-1.

Exhibit B-1: Cash Flow Components

Cash Flow Components	Cash Inflow	Cash Outflow
Upfront Premiums	√	
Annual Premiums	√	
Interest Income	√	
Net Claim Payments		√
Loss Mitigation Expenses		√
Refunded Upfront Premiums		√
Administrative Expenses ^a		√
Distributive Shares ^b		√

^a The administrative expense was discontinued since the FY 2002 Actuarial Review according to the Federal credit reform requirement.

^b The distributive share has been suspended since 1990. There is no indication that it will be resumed in the foreseeable future.

These components were projected quarterly for individual loans and then aggregated according to the product type and origination year, and also policy year for reporting purposes. Below, we discuss the derivation of each of these cash flows.

II. Background Information

The following definitions and background information clarify our discussion of the cash flow components:

- **Insurance-in-Force (IIF):** the nominal value of the unamortized original mortgage loan balances of the surviving mortgages insured by FHA. This is distinct from the conventional notion of amortized insurance-in-force, which includes only the current outstanding balances on surviving loans.
- **Conditional Claim Rate (CCR):** the number of loans that become claims during a time period divided by the number of surviving loans-in-force at the beginning of that period.
- **Conditional Prepayment Rate (CPR):** the number of loans being completely prepaid during a time period divided by the number of surviving loans-in-force at the beginning of that period.
- **Policy Year:** measures the number of fiscal years since origination. The year in which the mortgage is originated is assigned as fiscal policy year one, even though it may not be

a complete year.

- **Termination Year:** the fiscal year in which a mortgage terminates through a claim, prepayment or other reasons.
- **Unpaid Principal Balance (UPB) Factor:** the principal balance outstanding at a given time divided by the original mortgage amount. The UPB factor is calculated based only on amortization, given the original maturity, the type of mortgage, and the mortgage contract rate. For FRMs, the UPB factor for each quarter in the future can be directly computed using the initial contract rate and the amortization term. For ARMs, the UPB factor changes at different rates depending on the interest rate of the particular loan, which is updated according to the contractual rate-adjustment rule. In our model, the contract interest rates of ARM loans are updated by using changes in the one-year Treasury rate as an approximation for changes in the underlying index, subject to limits implied by FHA annual and lifetime rate-adjustment caps.

III. Cash Flow Components

We now describe the different cash flow components.

A. Premiums

1. Premium Structure

The primary source of revenue to the Fund is insurance premiums. If the Fund's mortgage insurance is priced to meet the expected liabilities, the insurance premiums collected and interest earned on them will cover all costs associated with mortgage loans insured by the Fund, under a normal economic environment. The insurance premium has been structured in different ways during different time periods. Details of the evolution of the premium structure are shown in Exhibits B-2, B-3 and B-4, and are as follows:

- For loans originated prior to September 1, 1983, the mortgage premium was collected on a monthly basis at an annualized rate of 0.50 percent of the outstanding principal balance for the period. To align this change with fiscal quarters, we assumed that this annual premium policy was in effect through September 30, 1983.

- Between September 1, 1983 and June 30, 1991, the mortgage premium was charged only upon loan origination and was based on a percentage of the original mortgage amount at the time of origination. This amount was 3.80 percent for 30-year mortgages and 2.40 percent for 15-year mortgages.
- Effective July 1, 1991, the National Affordable Housing Act specified a new premium structure. This structure specified an upfront premium of 3.80 percent for all product types except for 15-year non-streamline refinance loans (for which the upfront premium was set at 2.00 percent) and an annual renewal premium of 0.50 percent per year on the outstanding balance. The annual premium would cease at different policy years depending on the initial LTV of the loan.
- On October 1, 1992, the upfront premium for 30-year mortgages was reduced from 3.80 percent to 3.00 percent. The annual premium for 30-year mortgages was extended for a longer time period, while for 15-year mortgages, it was lowered to 0.25 percent for a shorter time period or completely waived if the initial LTV ratio was less than 90 percent.
- As of April 17, 1994, FHA lowered the upfront premium rate on 30-year mortgages from 3.00 percent to 2.25 percent. To align this change with fiscal quarters, we started applying this policy change on April 1, 1994.
- Starting from October 1, 1996, FHA lowered the upfront premium rate on 30-year mortgages for first-time homebuyers who receive homeowner counseling from 2.25 percent to 2.00 percent. This rate was further reduced to 1.75 percent for mortgages executed on or after September 22, 1997. This favorable treatment for borrowers with homeownership counseling was terminated shortly thereafter.
- Effective January 1, 2001, FHA lowered the upfront premium rate for all mortgages to 1.50 percent. The annual premium would stop as soon as the current LTV ratio of the loan was below 78 percent according to the home price as of the loan origination date. The annual premium was required to be paid for a minimum of five years for 30-year mortgages.

- Effective October 1, 2008, FHA charged an upfront premium rate of 1.75 percent for purchase money mortgages and full-credit qualifying refinances; and 1.50 percent for all types of streamline refinance loans. A varying annual premium, remitted on a monthly basis, was charged based on the initial loan-to-value ratio and maturity of the mortgage.
- Effective April 1, 2010, FHA changed the upfront premium to 2.25 percent for all mortgages executed after Apr 1, 2010.
- Effective October 4, 2010, FHA lowered the upfront premium of all mortgages to 1.0 percent. The annual premium for loans with 30-year terms was increased to 0.85 percent for LTV ratios up to 95 percent and to 0.90 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, an annual premium of 0.25 percent was set for LTV ratios greater than 90 percent. To align this change with fiscal quarters, we started applying this policy change on October 1, 2010.
- Effective April 18, 2011, the annual premium for loans with 30-year terms was increased to 1.10 percent for LTV ratios up to 95 percent and to 1.15 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, the annual premiums were increased to 0.25 percent for LTV ratios up to 90 percent and to 0.50 percent for LTV ratios greater than 90 percent. To align this change with fiscal quarters, we started applying this policy change on April 1, 2011.
- Effective April 9, 2012, FHA increased the upfront premium of all mortgages to 1.75 percent. The annual premium for loans with 30-years terms was increased to 1.20 percent for LTV ratios up to 95 percent, and to 1.25 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, the annual premiums were increased to 0.35 percent for LTV ratios up to 90 percent, and to 0.60 percent for LTV ratios greater than 90 percent. To align this change with fiscal quarters, we started applying this policy change on April 1, 2012.
- Effective June 11, 2012, the annual premium for loans with 30-year terms and base loan amounts above \$625,500 was increased to 1.45 percent for LTV ratios up to 95 percent,

and to 1.50 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, and base loan amount above \$625,500, the annual premium was increased to 0.60 percent for LTV ratios up to 90 percent, and to 0.85 percent for LTV ratios greater than 90 percent. Also effective June 11, 2012, for all single family Forward Streamline Refinance which are refinancing existing FHA loans that were endorsed on or before May 31, 2009, the upfront premium will decrease to 0.01 percent of the base loan amount, and the annual premium was set at 0.55 percent, regardless of the base loan amount. To align this change with fiscal quarters, we started applying this policy change on July 1, 2012.

- Effective April 1, 2013, the annual premium for loans with 30-year terms and base loan amounts below \$625,500 was increased to 1.30 percent for LTV ratios up to 95 percent, and to 1.35 percent for LTV ratios greater than 95 percent. The annual premium for loans with 30-year terms and base loan amounts above \$625,500 was increased to 1.50 percent for LTV ratios up to 95 percent, and to 1.55 percent for LTV ratios greater than 95 percent. For loans with 15-year terms and base loan amounts below \$625,500, the annual premium was increased to 0.45 percent for LTV ratios up to 90 percent, and to 0.70 percent for LTV ratios greater than 90 percent. For loans with 15-year terms and base loan amounts above \$625,500, the annual premium was increased to 0.70 percent for LTV ratios up to 90 percent, and to 0.95 percent for LTV ratios greater than 90 percent. This increase was effective for all forward mortgages except single family forward streamline refinance transactions that refinance existing FHA loans that were endorsed on or before May 31, 2009.
- Effective June 3, 2013, the annual premium rates for loans with an LTV of less than or equal to 78 percent and with terms of up to 15 years was 0.45 percent. The new payment period for annual premiums for loans with case numbers assigned on or after June 3, 2013 and with an LTV up to 90% was 11 years, and the annual premium applies for the life of the loan for LTVs greater than 90%. To align this change with fiscal quarters, we started applying these policy changes on July 1, 2013.

Exhibit B-2: Upfront Premium Rates for Fully Underwritten FHA Loans

Fiscal Year	30yr Loans, Fixed or Adjustable Rate (%)	15yr Loans, Fixed or Adjustable Rate (%)
9/1/83 to 6/30/91	3.8	2.4
7/1/91 to 9/30/92	3.8	2.00
10/1/92 to 4/16/94	3	2
4/17/94 to 9/30/96	2.25	2
10/1/96 to 9/21/97	2.25/2.00 ^a	2
9/22/97 to 12/31/00	2.25/2.00/1.75 ^a	2
1/1/01 to 9/30/08	1.5	1.5
10/1/08 to 4/4/10	1.75	1.75
4/5/10 to 10/3/10	2.25	2.25
10/4/10 and 4/8/12	1	1
4/9/12 and later	1.75	1.75

^a For first-time homebuyers who received homeowner counseling.

Exhibit B-3: Annual Premium Rate for 15- and 30-Year Fully Underwritten Mortgages

Fiscal Year	30yr Loans, Fixed or Adjustable	15yr Loans, Fixed or Adjustable
Prior to 9/1/1983	0.5% for life of loan	0.5% for life of loan
9/1/83 to 6/30/91	None	None
7/1/91 to 9/30/92	varies by LTV category ^a	varies by LTV category ^a
10/1/92 to 12/31/00	varies by LTV category ^b	varies by LTV category ^c
1/1/01 to 9/30/08	0.5% until loan balance reaches 78% of original property value, minimum of 5 years	varies by LTV category ^d
10/1/08 to 10/3/10	0.50% if LTV ≤ 95% 0.55% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0% if LTV ≤ 90% 0.25% if LTV > 90% until loan balance reaches 78% of original property value
10/4/10 to 4/17/11	0.85% if LTV ≤ 95% 0.90% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0% if LTV ≤ 90% 0.25% if LTV > 90% until loan balance reaches 78% of original property value
4/18/11 to 4/8/12	1.10% if LTV ≤ 95% 1.15% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0.25% if LTV ≤ 90% 0.50% if LTV > 90% until loan balance reaches 78% of original property value
4/9/12 to 6/10/12	1.20% if LTV ≤ 95% 1.25% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0.35% if LTV ≤ 90% 0.60% if LTV > 90% until loan balance reaches 78% of original property value
6/11/12 to 3/31/13	1.20% if LTV ≤ 95% & base loan amount ≤ \$625,500 1.25% if LTV > 95% & base loan amount ≤ \$625,500 1.45% if LTV ≤ 95% & base loan amount > \$625,500 1.50% if LTV > 95% & base loan amount > \$625,500 until loan balance reaches 78% of original property value, minimum of 5 years	0.35% if LTV ≤ 90% & base loan amount ≤ \$625,500 0.60% if LTV > 90% & base loan amount ≤ \$625,500 0.60% if LTV ≤ 90% & base loan amount > \$625,500 0.85% if LTV > 90% & base loan amount > \$625,500 until loan balance reaches 78% of original property value
4/1/13 to 6/2/13	1.30% if LTV ≤ 95% & base loan amount ≤ \$625,500 1.35% if LTV > 95% & base loan amount ≤ \$625,500 1.50% if LTV ≤ 95% & base loan amount > \$625,500 1.55% if LTV > 95% & base loan amount > \$625,500 until loan balance reaches 78% of original property value, minimum of 5 years	0.45% if LTV ≤ 90% & base loan amount ≤ \$625,500 0.70% if LTV > 90% & base loan amount ≤ \$625,500 0.70% if LTV ≤ 90% & base loan amount > \$625,500 0.95% if LTV > 90% & base loan amount > \$625,500 until loan balance reaches 78% of original property value

6/3/13 and later	1.30% if LTV ≤ 95% & base loan amount ≤ \$625,500 1.35% if LTV > 95% & base loan amount ≤ \$625,500 1.50% if LTV ≤ 95% & base loan amount > \$625,500 1.55% if LTV > 95% & base loan amount > \$625,500 If LTV ≤ 90%, 11 years; if LTV > 90%, life of loan	0.45% if 78% < LTV ≤ 90% & base loan amount ≤ \$625,500 0.70% if LTV > 90% & base loan amount ≤ \$625,500 0.70% if 78% < LTV ≤ 90% & base loan amount > \$625,500 0.95% if LTV > 90% & base loan amount > \$625,500 0.45% if LTV ≤ 78% If LTV ≤ 90%, 11 years; if LTV > 90%, life of loan		
LTV Range:	a	b	c	d
below 90%	0.5% for 5 yrs	0.5% for 7 yrs	0%	0%
Between 90%~95%	0.5% for 8 yrs	0.5% for 12 yrs	0.25% for 4 yrs	0.25% until LTV reaches 78%
above 95%	0.5% for 10 yrs	0.5% for 30 yrs	0.25% for 8 yrs	0.25% until LTV reaches 78%

Exhibit B-4: Premium Rates for Streamline Refinance Loans

Period of Origination	30-Year Mortgages		15-Year Mortgages	
	Upfront Premium	Annual Premium	Upfront Premium	Annual Premium
7/1/91 to 9/30/92	3.80%	0.5% for first 7 years	3.80%	0.5% for first 7 years
10/1/92 to 4/16/94	3.00%	0.5% for first 7 years	2.00%	None
4/17/94 to 12/31/00	2.25%	0.5% for first 7 years	2.00%	None
1/1/01 to 9/30/08	1.50%	0.5% until loan balance reaches 78% of original property value, minimum of 5 years	1.50%	0.25% if LTV > 90% ^a until loan balance reaches 78% of original property value
10/1/08 to 3/31/10	1.50%	0.50% if LTV ≤ 95%, 0.55% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	1.50%	0.25% if LTV > 90% ^a until loan balance reaches 78% of original property value
4/1/10 to 10/3/10	2.25%	0.50% if LTV ≤ 95%, 0.55% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	2.25%	0.25% if LTV > 90% ^a until loan balance reaches 78% of original property value

10/4/10 to 4/17/11	1.00%	0.85% if LTV ≤ 95%, 0.90% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	1.00%	0.25% if LTV > 90% ^a until loan balance reaches 78% of original property value
4/18/11 to 4/8/12	1.00%	1.10% if LTV ≤ 95% & base loan amount ≤ \$625,500 1.15% if LTV > 95% & base loan amount ≤ \$625,500 1.35% if LTV ≤ 95% & base loan amount > \$625,500 1.40% if LTV > 95% & base loan amount > \$625,500 until loan balance reaches 78% of original property value, minimum of 5 years	1.00%	0.25% if LTV ≤ 90% & base loan amount ≤ \$625,500 0.50% if LTV > 90% & base loan amount ≤ \$625,500 0.5% if LTV ≤ 95% & base loan amount > \$625,500 0.75% if LTV > 95% & base loan amount > \$625,500 until loan balance reaches 78% of original property value
4/9/12 to 3/31/13	1.75%	1.10% if LTV ≤ 95% & base loan amount ≤ \$625,500 1.15% if LTV > 95% & base loan amount ≤ \$625,500 1.35% if LTV ≤ 95% & base loan amount > \$625,500 1.40% if LTV > 95% & base loan amount > \$625,500 until loan balance reaches 78% of original property value, minimum of 5 years	1.75%	0.25% if LTV ≤ 90% & base loan amount ≤ \$625,500 0.50% if LTV > 90% & base loan amount ≤ \$625,500 0.5% if LTV ≤ 95% & base loan amount > \$625,500 0.75% if LTV > 95% & base loan amount > \$625,500 until loan balance reaches 78% of original property value
4/1/13 to 6/2/13 ^b	1.75% ^b	1.30% if LTV ≤ 95% & base loan amount ≤ \$625,500 1.35% if LTV > 95% & base loan amount ≤ \$625,500 1.50% if LTV ≤ 95% & base loan amount > \$625,500 1.55% if LTV > 95% & base loan amount > \$625,500, until loan balance reaches 78% of original property value, minimum of 5 years ^b	1.75% ^b	0.45% if LTV ≤ 90% & base loan amount ≤ \$625,500 0.70% if LTV > 90% & base loan amount ≤ \$625,500 0.70% if LTV ≤ 95% & base loan amount > \$625,500 0.95% if LTV > 95% & base loan amount > \$625,500, until loan balance reaches 78% of original property value ^b

6/3/13 and later ^b	1.75% ^b	1.30% if LTV ≤ 95% & base loan amount ≤ \$625,500 1.35% if LTV > 95% & base loan amount ≤ \$625,500 1.50% if LTV ≤ 95% & base loan amount > \$625,500 1.55% if LTV > 95% & base loan amount > \$625,500, If LTV ≤ 90%, 11 years; if LTV > 90%, life of loan ^b	1.75% ^b	0.45% if 78% < LTV ≤ 90% & base loan amount ≤ \$625,500 0.70% if LTV > 90% & base loan amount ≤ \$625,500 0.70% if 78% < LTV ≤ 90% & base loan amount > \$625,500 0.95% if LTV > 90% & base loan amount > \$625,500 0.45% if LTV ≤ 78% If LTV ≤ 90%, 11 years; if LTV > 90%, long term ^b
6/11/12 and later ^c	0.01% ^c	0.55% until loan balance reaches 78% of original property value, minimum of 5 years ^c	0.01% ^c	0.55% until loan balance reaches 78% of original property value ^c

^a 0% if original LTV is equal to or below 90 percent.

^b Applies to all forward mortgages except single family forward streamline refinance transactions that refinance existing FHA loans that were endorsed on or before May 31, 2009 (see ML 2012-4).

^c Only applies to SF Forward Streamline Refinance transactions that are refinancing existing FHA loans that were endorsed before May 31, 2009.

2. Upfront Premium

The upfront premium is assumed to be fully paid at the mortgage origination date and the amount is calculated as follows:

$$\text{Upfront Premium Payment} = \text{Origination Loan Amount} * \text{Upfront Insurance Premium Rate}$$

In practice, FHA offers a premium finance program to those qualified for mortgage insurance, so that the upfront premium does not add to the borrower's equity burden at the beginning of the contract. Instead, the borrower can add it to the original loan balance, in essence paying the upfront premium at the same schedule as their principal balance. The annual premium is charged based on the unpaid principal balance excluding the financed upfront premium. Almost all borrowers finance their upfront premiums in this fashion. However, the LTV including refinanced upfront premiums cannot exceed 97.5 percent.

3. Annual Premium

The annual premium is calculated as follows:

$$\text{Quarterly Payment of Annual Premium} = \text{Amortized UPB (excluding any upfront premiums)} * \text{Annual Insurance Premium Rate}$$

The premium is actually collected on a monthly basis. The above formula models the premium as being collected at the beginning of each quarter for purposes of our analysis. In addition, the termination rate will have impacts on future premium flows. In particular, all potential future premium income would no longer be paid when the particular mortgage loan is prepaid or becomes a claim.

The annual premium is not assessed on the amount of the financed upfront premium.

B. Losses Associated with Claims

The Fund's largest expense component comes in the form of payments arising from claims. FHA pays the claim to the lender after a lender files a claim. Traditionally, in most cases, FHA takes possession of the foreclosed property and sells the property to partially recover the loss. This particular type of claim is called a conveyance.

Based on this practice, claim cash flows can be decomposed into two components:

- Cash outflow of the claim payment at the claim date including expenses incurred, and
- Cash inflow of any net proceeds received in selling the conveyed property at the property disposition date.

For tractability, we simplify this two-step cash flow into one lump-sum amount. We also separately estimate losses from pre-foreclosure sales, wherein the property is sold prior to the completion of a foreclosure and the property is not conveyed to HUD (see Appendix E). The claim loss payment estimated in our model at time t is

$$\text{Claim Loss}_t = \text{Amortized Surviving UPB}_t * \text{Conditional Claim Rate}_t * \text{Loss Rate}_t$$

For this review, we applied a dynamic simulation approach that simulates loan transitions to default, claim and prepayment that reflect the probabilities of the various transitions (see Appendix B). But in effect, the *Amortized Surviving UPB_t* is the amount of the unpaid balance of the loan after amortization multiplied by the probability that the loan will survive until the beginning of time t . The conditional claim rates are estimated using the multinomial mortgage termination model presented in Appendix A.

The loss rate is usually referred to as the loss given default (LGD) or “severity” in the banking industry. It measures the amount of principal not recovered divided by the unpaid principal balance at the time of claim. The loss rate is predicted as weighted average loss rates among conveyance, pre-foreclosure sales, and the newly implemented policy of third party sale where the weights reflect the probability that a claim is associated with individual type of claims. For additional technical details, see Appendix E.

C. Loss Mitigation Expenses

HUD initiated a loss mitigation program in 1996 in an effort to provide opportunities for distressed FHA insured borrowers to retain homeownership. Loss mitigation also reduces foreclosure costs. In the standard process, the mortgagees provide default counseling for borrowers who are behind in their payments, and offer appropriate loss mitigation options to prevent borrowers from losing their homes.

The loss mitigation program include: (1) special forbearance, (2) loan modification, and (3) partial claim. A special forbearance is a written repayment agreement between the mortgagee and the borrower that contains a plan to reinstate a loan. A loan modification modifies the contractual terms of mortgage permanently, such as lowering the interest rate, increasing the loan term, or reducing the principal balance. Under the partial claim option, a mortgagee will advance funds on behalf of a mortgagor in an amount necessary to reinstate a delinquent loan. The borrowers are required to sign a promissory note and a subordinated mortgage payable to FHA.

Loan mitigation cases increased significantly from FY 2007 to FY 2013, the latest fiscal year with reliably finalized cash flows. There were 86,527 loss mitigation claims in FY 2007 which increased to 177,442 cases in FY 2013. The amount FHA paid in these cases after all adjustments and curtailments was \$158.57 million in FY 2007 which increased to \$1.41 billion in FY 2013. Loss mitigation payments made by FHA include administrative fees, costs of title searches, recording fees, and subordinated mortgage note amounts.

To estimate the loss mitigation payment, we estimated a linear regression model with zero constant term and the total claim losses during the quarter as the explanatory variable:

$$\text{Loss Mitigation Payment} = 0 + b * \text{Claim Losses}$$

The estimation uses quarterly aggregated data for loss mitigation payment amounts and total claim losses from FY 2002 through FY 2009. The estimated coefficient of claim losses is 0.0663, meaning that loss mitigation expenses are typically about 6.63 percent of the total claim losses during an exposure quarter.

D. Refunded Premiums

FHA first introduced the upfront premium refund program in 1983. It specified that FHA would refund a portion of the upfront premium when a household prepaid its mortgage. The upfront premium was considered to be “earned” over the life of the loan. Upon prepayment, an approximation of the unearned upfront premium is returned to the borrower. Therefore, the amount of the refund depends on the time from origination to when the mortgage is prepaid. For modeling purposes, the refund payments are calculated as follows:

$$\begin{aligned} \text{Refund Payments} = \\ \text{Original UPB} * \text{Upfront Premium Rate} * \text{Conditional Prepayment Rate} * \text{Refund Rate} \end{aligned}$$

In the past, borrowers always receive the upfront premium refund when they prepaid their mortgages before the maturity of the mortgage contract. In 2000, FHA changed its policy so that borrowers would obtain refunds only if they prepaid within the first five years of their mortgage contracts. The most recent policy change at the end of 2004 eliminated refunds for early prepayments of any mortgages endorsed after that date, except for those borrowers who refinanced into a new FHA loan within 3 years following the original endorsement date.

The upfront premium refund rate schedules for different endorsement dates are presented in Exhibit B-5.

Exhibit B-5: Percentage of Upfront Premium Refunded

Years since Origination	9/1/83~12/31/93		1/1/94~12/31/00 ^a	1/1/01 and later ^b	12/8/2004 and later ^c
	30-Year Mortgages	15-Year Mortgages	All Mortgages	All Mortgages	If Refinanced into Another FHA Loan
1	0.99	0.99	0.95	0.85	0.58
2	0.94	0.93	0.85	0.65	0.34
3	0.82	0.81	0.70	0.45	0.10
4	0.67	0.66	0.49	0.25	0.00
5	0.54	0.51	0.30	0.10	
6	0.43	0.39	0.15	0.00	
7	0.35	0.29	0.04		
8	0.29	0.21	0.00		
9	0.24	0.15			
10	0.21	0.11			
11	0.18	0.08			
12	0.16	0.06			
13	0.15	0.04			
14	0.13	0.03			
15	0.12	0.02			
16	0.11	0.00			
17	0.10				
18	0.09				
19	0.09				
20	0.08				
21	0.07				
22	0.07				
23	0.06				
24	0.05				
25	0.05				
26	0.04				
27	0.04				
28	0.04				
29	0.04				
30	0.00				

^a Based on Mortgagee Letter 94-1, which provided a monthly schedule of refund rates

^b Based on Mortgagee Letter 00-38

^c Based on Mortgagee Letter 05-03, which provided a monthly schedule of refund rates. Applicable only if refinanced into a new FHA loan.

IV. Economic Value

Once all the above future cash flow components are estimated, their present value can be computed through discounting them at an appropriate rate. The economic value is the sum of the present value of future net cash flows plus the current capital resources.

A. Discount Factors

The discount factors applied in computing the present value of cash flows are the quarterly Federal credit subsidy present value conversion factors published by the Office of Management and Budget (OMB). The credit subsidy discount factors for the 2015 President’s Budget reflect the most recent Treasury yield curve, which captures the Federal government’s cost of capital in raising funds. These factors reflect the capital market’s expectation of the consolidated interest and credit risk of the US Treasury securities. The discount factors are shown in Exhibit B-6. As an example, a cash flow occurring at the end of FY 2015 is multiplied by 0.9985 to convert it into a present value for year-end FY 2014. The discount factors used in this Review are lower than the corresponding discount factors in last year’s Review.

Exhibit B-6: OMB Discount Factors

Year that Cash Flow Occurs	Discount Factor	Year that Cash Flow Occurs	Discount Factor	Year that Cash Flow Occurs	Discount Factor
2015	0.9972	2026	0.6597	2037	0.3957
2016	0.9857	2027	0.6295	2038	0.3779
2017	0.9639	2028	0.6007	2039	0.3609
2018	0.9343	2029	0.5734	2040	0.3447
2019	0.8995	2030	0.5473	2041	0.3293
2020	0.8640	2031	0.5224	2042	0.3145
2021	0.8292	2032	0.4987	2043	0.3004
2022	0.7943	2033	0.4761	2044	0.2870
2023	0.7594	2034	0.4546	2045	0.2741
2024	0.7247	2035	0.4340	2046	0.2619
2025	0.6914	2036	0.4144	2047	0.2501

B. Calculating the Economic Value

The economic value of the Fund as of the end of FY 2014 was calculated first by determining the present value of the future cash flows for all surviving loans as of September 30, 2014. This figure was then added to the capital resources of the Fund, estimated as of the same date.

For each fiscal year beyond 2014, the economic value of the fund as of the end of the fiscal year is calculated by the following equation:

$$\begin{aligned} \text{Year End Economic Value} = & \\ & \text{Economic Value at the beginning of the year} + \text{Total Investment Return on the Beginning} \\ & \text{Economic Value} + \text{Economic Value of the New Book of Business} \end{aligned}$$

The return on investment of the beginning economic value for each of the future fiscal years is assumed to equal the one-year Treasury forward rates implied by the most recent Federal credit subsidy discount factors. Specifically, these rates are shown in Exhibit B-7.

Exhibit B-7: Interest Rate Earned by the Fund

Fiscal Year	Interest Rate (%)
2015	0.28%
2016	1.17%
2017	2.26%
2018	3.17%
2019	3.87%
2020	4.11%
2021	4.20%

V. Cash Flow Overrides

A. Asset Sales Override

FHA began selling distressed single-family loans through what is now the *Distressed Asset Stabilization Program* in 2010, and has been aggressively pursue this alternative disposition approach since 2012⁵¹. It has sold more than 54,000 single family loans to date.⁵² Most recently, HUD sold 5,904 loans under this program in June and July 2014, and another 14,648 loans with

⁵¹ Distressed Asset Stabilization Program Announcement , July18,2012

http://portal.hud.gov/hudportal/HUD?src=/press/press_releases_media_advisories/2012/HUDNo.12-116

⁵² HUD internal loss severity report, July 2014.

winning bid prices in a single deal. The average loss severity rate is 45.26 percent. Historically 25 percent of all loans that were put on the market will fall out. We received the exact loan identification of these loans from HUD and we estimate 16,614 loans in this deal to be terminated due to note sale. The claim losses of these sold loans are assumed to incur at the end of 2014Q3 and 2014Q4.

In addition, FHA has provided us the loan identification numbers of another 28,341 loans that will be put for sale in September 2014. Based on the June sale record, we assume about 75 percent or 21,242 of these loans would be sold with an average loss severity rate of 45.26 percent estimated from the June note sale. The claim losses of these September note sales are assumed to incur at the end of 2015Q1.

There are altogether 37,856 loans that need to be overridden with loss severity levels as observed for the June note sale, which are considerably lower than the REO loss severity rate. Therefore, there is a significantly improvement of the NPV when Note Sale override treatment is implemented.

B. Foreclosed Loans and Delayed Claim Override

After the U.S. mortgage market meltdown, the number of delinquent loans increased dramatically. Starting in 2008, lenders that did not follow appropriate procedures to foreclose mortgages and had been subsequently penalized. Since then many lenders took extra precautions in the foreclosure procedures to avoid the risk of not being paid by the mortgage insurers. As of June 30, 2014, FHA had 136,735 loans that have begun the foreclosure process, or have completed the foreclosure process but have not yet filed claims. In the meanwhile, we observed a large decrease in claim cases after FY 2009 partially because of the foreclosure moratorium policy and partially due lenders' extra precaution in the execution of foreclosure process. In this year's model, we identified 20,950 loans in default that have completed foreclosure but have not yet been filed as claims as of end of July 2014. We assume claims of losses for these loans will start arriving in FY 2014Q4.

We adjust the termination process for loans that have completed foreclosure but have not yet been claimed. We assume all these loans will eventually become claims. The model described below is used to estimate the timing of the claim filing of these loans.

First, we use information from all loans terminated between 1983Q1 and 2013Q2 to estimate the foreclosure-to-claim duration. Specifically, we assume the claim likelihood follows an exponential distribution after the date that auction is held or foreclosure is completed. The time lag from auction to claim and the time lag from foreclosure completion to claim are calibrated to the exponential density functions in the following form:

$$f(x; \theta, \sigma) = \begin{cases} \frac{1}{\sigma} e^{-\frac{x-\theta}{\sigma}}, & x \geq \theta, \\ 0, & x < \theta \end{cases}$$

Where x denotes either the auction-to-claim lag or the foreclosure-to-claim lag, θ and σ are the expected and the standard deviation of the lag.

These two distributions are estimated separately at the state level.

After modeling the two time lags, we use the following rule to simulate loans that need adjustment, which would accelerate their terminations. Any loans which had auctions held prior to January 1st, 2013 or foreclosure completed prior to July 1st, 2013 are assumed to be claimed following this accelerated termination process.

For each loan, we simulate its termination lag time in quarters from 2014Q4 using the corresponding estimated exponential distribution. The following table summarizes the simulated termination outcome.

Exhibit B-8: Special Treatment for Foreclosure Backlog

Termination Lag	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	8271	39.48	8271	39.48
1	6826	32.58	15097	72.06
2	2796	13.35	17893	85.41
3	1302	6.21	19195	91.62
4	704	3.36	19899	94.98
5	393	1.88	20292	96.86
6	231	1.1	20523	97.96
7	141	0.67	20664	98.63
8 to 26	286	1.34	20950	100

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Appendix C
Data for Loan Performance Simulations

Appendix C: Data for Loan Performance Simulations

This appendix describes the methodology used to produce the data necessary for the forecasts of future loan performance. We first describe how loan event data for future time periods were generated to project future loan performance and mortgage-related cash flows. This requires creating future event data both for existing books of business and for future loan cohorts not yet originated. Then we summarize how the economic forecasts were applied. The economic forecasts are discussed in Appendix D.

I. Future Loan Event Data

The development of future loan event data was closely integrated with the development of the data used in the statistical estimation of loan performance. As described in Appendix A, the process of building the historical loan event data entailed expanding FHA loan origination records into dynamic quarter-to-quarter event data from loan origination up to and including the period of loan termination. The loan event data were used to derive a number of conditional loan status transition rates. The transition events are current-to-current, current-to-default (default is 90+ days delinquent), current-to-current_X (default and cure within same quarter), current-to-streamline refinance, current-to-prepay, default-to-default, default-to-claim, default-to-prepay, default-to-cure by significant modification assistance, and default-to-cure with low or no modification assistance.

For loans that did not terminate and are still in either current or in default status as of end of FY 2014Q2, the process of building the future quarter-by-quarter event data followed the same procedure as for terminated loans, but used forecasted values of external economic factors to project future loan termination rates and cash flows.

In addition, for the purpose of projecting future economic values, we forecasted the loan performance of future FHA books originated through FY 2021. The dollar endorsement volumes for FY 2014 through FY 2021 are projected by our FHA mortgage volume model described in Appendix F. Based on Moody's baseline economic forecasts, Exhibit C-1 shows the volume model's projected dollar volumes and product share distribution.

These projected volumes are allocated among the three loan-product types (only for fully underwritten loans) following their distribution in the most recent endorsements over FY 2013Q3 to FY 2014Q2. HUD provided detailed projections of the compositions of these future books of business by LTV and credit score. Exhibits C-2 and C-3 present HUD's projected composition for for-purchase and fully underwritten refinance mortgages. Also, we assumed

stable proportions of product types for fully underwritten mortgages over FY 2014 to FY 2021 as presented in Exhibit C-4.

Exhibit C-1: Forecasted FHA Dollar Volumes (\$ mm) and Shares

Period	FHA Purchase Volume	FHA Fully Underwritten Refi Volume	FHA Streamline Refi Volume	Total FHA Volume
FY2014	\$106,260	\$11,312	\$16,429	\$134,000
FY2015	\$105,619	\$10,494	\$8,392	\$124,505
FY2016	\$103,184	\$5,931	\$4,373	\$113,488
FY2017	\$103,291	\$8,910	\$6,864	\$119,065
FY2018	\$105,814	\$15,678	\$15,391	\$136,883
FY2019	\$109,704	\$15,545	\$16,089	\$141,338
FY2020	\$113,570	\$15,448	\$18,529	\$147,547
FY2021	\$118,841	\$17,454	\$23,166	\$159,462

Period	FHA Purchase Share	FHA Fully Underwritten Refi Share	FHA Streamline Refi Share
FY2014	79.30%	8.44%	12.26%
FY2015	84.83%	8.43%	6.74%
FY2016	90.92%	5.23%	3.85%
FY2017	86.75%	7.48%	5.77%
FY2018	77.30%	11.45%	11.24%
FY2019	77.62%	11.00%	11.38%
FY2020	76.97%	10.47%	12.56%
FY2021	74.53%	10.95%	14.53%

Exhibit C-2: Base-Case Composition of For-Purchase Mortgages

Loan-to-Value Ratio	Term	Projected Composition of FY 2014 - 2021 Purchase Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
$X \leq 90$	30 Yr	0.04%	0.00%	0.02%	0.24%	1.21%	0.93%	1.59%	1.06%
	15 Yr	0.45%	0.00%	0.00%	0.45%	3.49%	3.04%	10.07%	6.41%
$90 < X \leq 95$	30 Yr	0.04%	0.00%	0.02%	0.32%	2.25%	1.64%	2.78%	2.08%
	15 Yr	0.06%	0.00%	0.11%	0.39%	3.26%	2.59%	5.51%	3.71%
$95 < X$	30 Yr	0.33%	0.00%	0.00%	1.80%	22.72%	17.09%	25.12%	18.72%
	15 Yr	0.51%	0.00%	0.00%	0.84%	12.94%	11.02%	19.52%	15.64%

Exhibit C-3: Base-Case Composition of Fully Underwritten Refinance Loans

Loan-to-Value Ratio	Term	Projected Composition of FY 2014 - 2021 Fully Underwritten Refinance Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
$X \leq 90$	30 Yr	0.10%	0.00%	0.89%	5.34%	24.43%	15.15%	18.63%	8.52%
	15 Yr	0.04%	0.00%	0.08%	3.92%	20.55%	15.10%	23.16%	17.15%
$90 < X \leq 95$	30 Yr	0.01%	0.00%	0.19%	0.48%	2.94%	2.07%	2.95%	2.19%
	15 Yr	0.00%	0.00%	0.00%	0.18%	1.62%	1.37%	2.38%	3.12%
$95 < X$	30 Yr	0.01%	0.00%	0.59%	0.83%	3.86%	2.81%	4.04%	3.96%
	15 Yr	0.00%	0.00%	0.00%	0.31%	1.50%	1.85%	3.28%	4.39%

Exhibit C-4: Product Type Distribution of Fully Underwritten Mortgages for FYs 2014Q2-2021Q4

Product Type	Proportion
Fixed-Rate 30 Year Mortgages	93.75%
Fixed-Rate 15 Year Mortgages	3.12%
Adjustable Rate Mortgages	3.13%

The development of loan-level data for future loans is as follows. Each future loan cohort is based on duplication of the loan-level data records for the last full year of historical data – corresponding to the last two quarters of FY 2013 and the first two quarters of FY 2014. While this basic approach imposes the assumption that future detailed loan characteristics occur with the same distribution as the recent FHA endorsements, several adjustments are made to ensure consistency with future economic conditions and volume forecasts. In particular, the starting mortgage coupon rates for all products are updated to reflect forecasted market conditions at the

time of origination of these projected future cohorts. This is achieved by adjusting the loan-level coupons up or down by the same percentage change as occurred for the average market mortgage rate.

As mentioned in Appendix A, we implemented the full dynamic simulation method for streamline refinance (SR) loan originations. As all SR loan originations are generated endogenously from the previous cohorts, according to our transition models to streamline refinance, it is not necessary to make exogenous adjustments for SR loan originations.

II. Future Economic Forecasts

Moody's Analytics serves as our source for the quarterly economic forecast of interest rates and house price appreciation rates. For the projection of future changes in housing values, we used Moody's forecast of the FHFA MSA-level and state-level purchase only housing price indices. Because the Moody's baseline HPI forecast is an expected trend forecast, it tends to smooth out intertemporal volatility in house price appreciation rates. There is also an additional layer of uncertainty with regard to the dispersion of individual house price appreciation rates around the market average, represented by the local-level HPI. When using Moody's local house price forecasts to compute the probability of negative equity, it is important to take into account both sources of uncertainty. We adopt the Yang, Lin, and Cho (2011) methodology to incorporate these two sources of dispersion of future house price indexes at each location.⁵³ Specifically, Equation (8) in Appendix A of this Review is modified as follows for all future time periods:

$$\sigma(t) = \sqrt{a \cdot t + b \cdot t^2}$$

where parameters "a" and "b" were estimated by FHFA for each location.

Local purchase-only HPI is published by FHFA. In assigning metropolitan area indices, we first used the Metropolitan Statistical Area Division (MSAD) index if the index exists for the loan's Federal Information Processing Standards (FIPS) state-county code. If the MSAD index does not exist, we used the Core Based Statistical Area (CBSA) index if that index is available. In case neither the MSAD nor the CBSA index is available, we applied the corresponding state-level HPIs.

As described in Appendix A, the indices are used in conjunction with estimates of house price diffusion parameters to compute probabilities of negative equity at each loan age for individual borrowers. The dispersion estimates reflect the deviations among individual house price

⁵³ See Equation (20) in Yang, Tyler T., Che-Chun Lin, and Man Cho, "Collateral Risk in Residential Mortgage Defaults," *Journal of Real Estate Finance and Economics*, Vol. 42, No. 2, pp. 115-142, 2011.

appreciation rates around the MSA or state average appreciation rates computed retrospectively by the HPIs.

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Appendix D
Economic Forecasts

Appendix D: Economic Forecasts

In order to measure the Fund's resilience against potential future losses on current and future portfolios, the economic value of the Fund was estimated under the Monte Carlo simulation framework and also for six alternative deterministic economic scenarios. Our Monte Carlo paths are centered on Moody's base forecast in the sense that our values are just as likely to lie above the Moody's forecast as they are to lie below them. For this calibration we used the July 2014 forecast of the U.S. economy published by Moody's Analytics. For purposes of our Review, the components of Moody's forecast are:

- FHFA Purchase-Only Home Price Index (HPIs) at the MSA and Census division levels
- Unemployment rates at the MSA and Census division levels
- Ten-year constant maturity Treasury rate
- One-year constant maturity Treasury rate
- Commitment rate on 30-year fixed-rate mortgages

A summary of these time series data, used in the baseline simulation is presented in Exhibit D-1. We used a quarterly frequency and a local HPI and unemployment rate in deriving the economic value of the MMI Fund and in alternative scenarios. The quarterly economic factors forecasted by Moody's are available from FY 2014 through FY 2044.

Exhibit D-1: Summary of Moody's Baseline Forecasts

Economic Forecast^a					
Fiscal Year	FHFA Purchase-Only Home Price Index	Commitment Rate on 30-Year Fixed-Rate (%)	1-Year Treasury Rate (%)	10-Year Treasury Rate (%)	National Unemployment Rate
2014	209.22	4.33	0.13	2.77	6.50
2015	218.83	4.91	0.24	3.51	6.06
2016	222.78	5.93	1.37	4.58	5.75
2017	225.04	6.29	2.80	4.84	5.26
2018	229.49	6.01	3.35	4.52	4.85
2019	234.95	6.01	3.48	4.53	4.84
2020	241.63	6.03	3.61	4.55	4.89
2021	249.77	6.07	3.81	4.60	4.89
2022	258.52	6.15	3.95	4.69	4.87
2023	267.33	6.17	3.98	4.69	4.88
2024	276.37	6.16	3.96	4.68	4.88

^a Source: Moody's Analytics July 2014 Forecast. Numbers are average levels during each fiscal year.

I. Alternative Scenarios

To assess the effect of stress scenarios on the Fund's economic value, six alternative scenarios were used. These six scenarios are:

- Moody's July 2014 Base Line Deterministic Scenario
- 10th Best Path in Simulation (of 100 paths)
- 25th Best Path in Simulation
- 25th Worst Path in Simulation
- 10th Worst Path in Simulation
- Worst Path in Simulation
- Moody's Protracted Slump Scenario

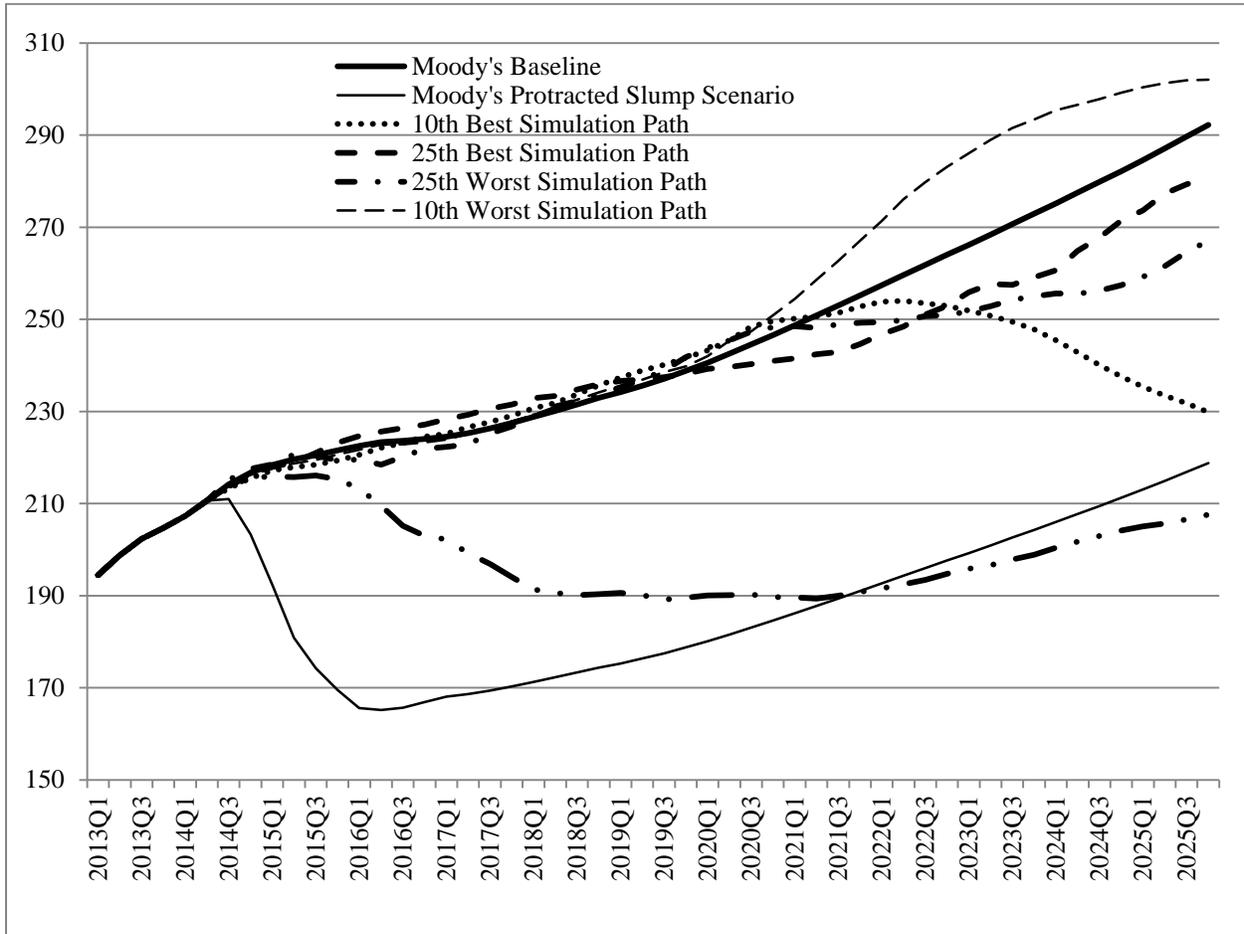
The details of constructing different stochastic simulation paths are presented in Appendix G. The sixth scenarios were based on modified versions of the July 2014 alternative economic forecasts published by Moody's Analytics. Moody's projection of alternative future scenarios assumes that the local house price appreciation rate (HPA) will change from that of the baseline scenario by a constant rate from the base forecast scenario across all locations for each future quarter.

Moody's also assumes that future HPI levels will converge to those of the baseline scenario. This assumption implies that under pessimistic scenarios, the lower short-term HPA will be followed by a period of stronger HPA. Instead of assuming that the HPI will converge to a stable level in the long run, an alternative assumption widely used in the mortgage industry is that HPA will converge to a stable rate. As in last year's Review, we modified Moody's alternative HPI scenario to be consistent with this view. Specifically, the quarterly HPA rates were computed for the baseline and the Moody's alternative scenario. The alternative scenario follows the original Moody's HPA path until the quarterly HPA crosses that of the baseline scenario. Following the quarter of the HPA's cross-over, the HPA of the baseline scenario is applied to generate the remainder of the scenario. The cross-over quarter is FY 2016 Q4. This modification ensures that the HPA rate in a pessimistic scenario never exceeds that of the baseline scenario.

II. Graphical Depiction of the Scenarios

Exhibit D-2 shows the future movements of the national HPI under the baseline and the six alternative economic scenarios. This graph shows that the differences among these scenarios depend on the severity and duration of the housing recession. Under the baseline scenario, the HPI does not return to its FY 2007 level until FY 2017, and this does not happen until FY 2029 for the most pessimistic scenario among Monte Carlo simulated scenarios.

Exhibit D-2: Paths of the Future National House Price Index in Different Scenarios



Exhibits D-3a and D-3b show the forecasted mortgage rate of 30-year fixed-rate mortgages in the baseline and the six alternative scenarios. Moody’s forecasts that the mortgage rates will rise to 6.33 percent in nine quarters and revert to around 6.0 percent in FY 2017. In addition, Moody’s model that generated the scenarios suggests stagflation wherein the protracted slump scenario coincides with the highest levels of rates.

Exhibit D-3a: Paths of the Future Mortgage Rate (%) in Different Scenarios

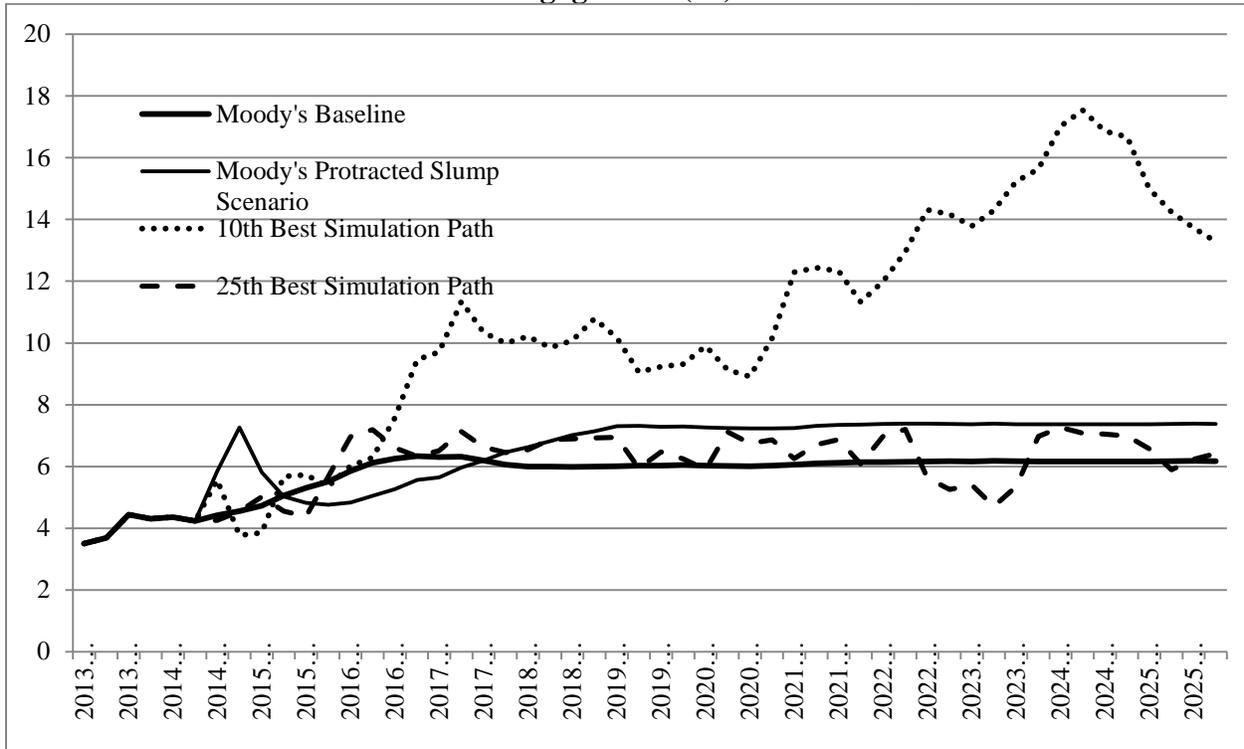


Exhibit D-3b: Paths of the Future Mortgage Rate (%) in Different Scenarios

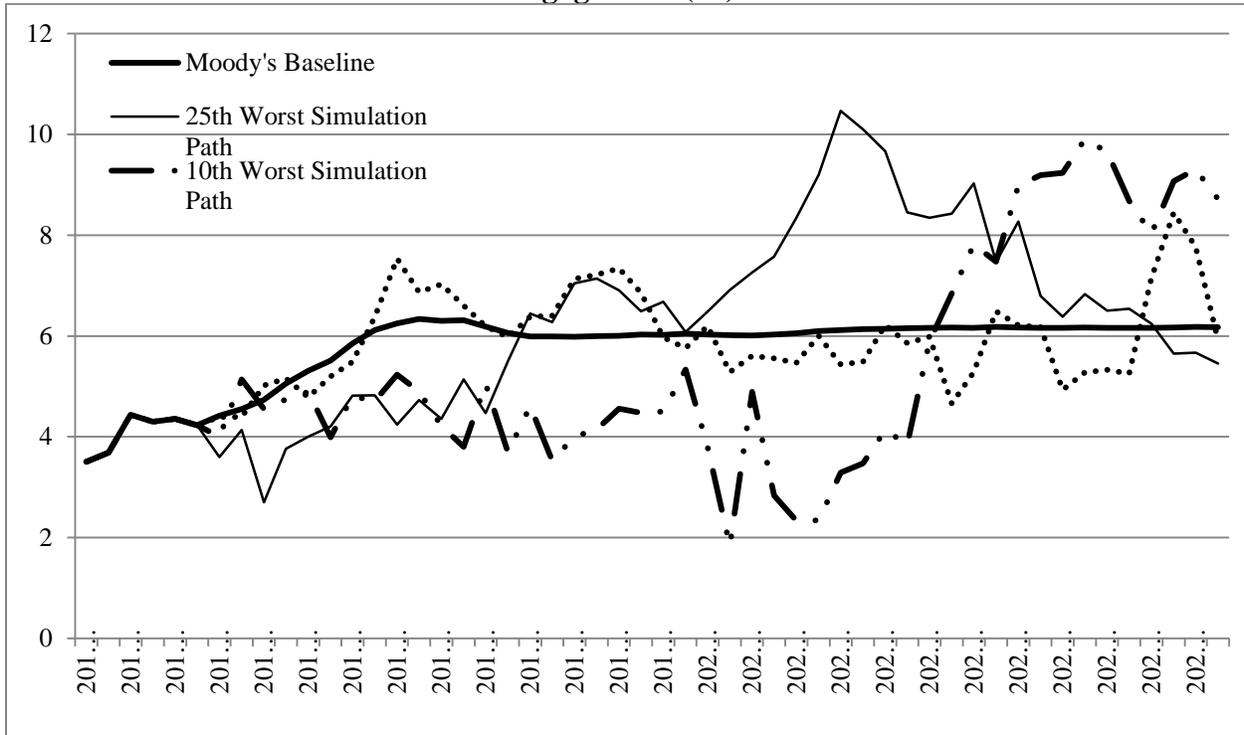
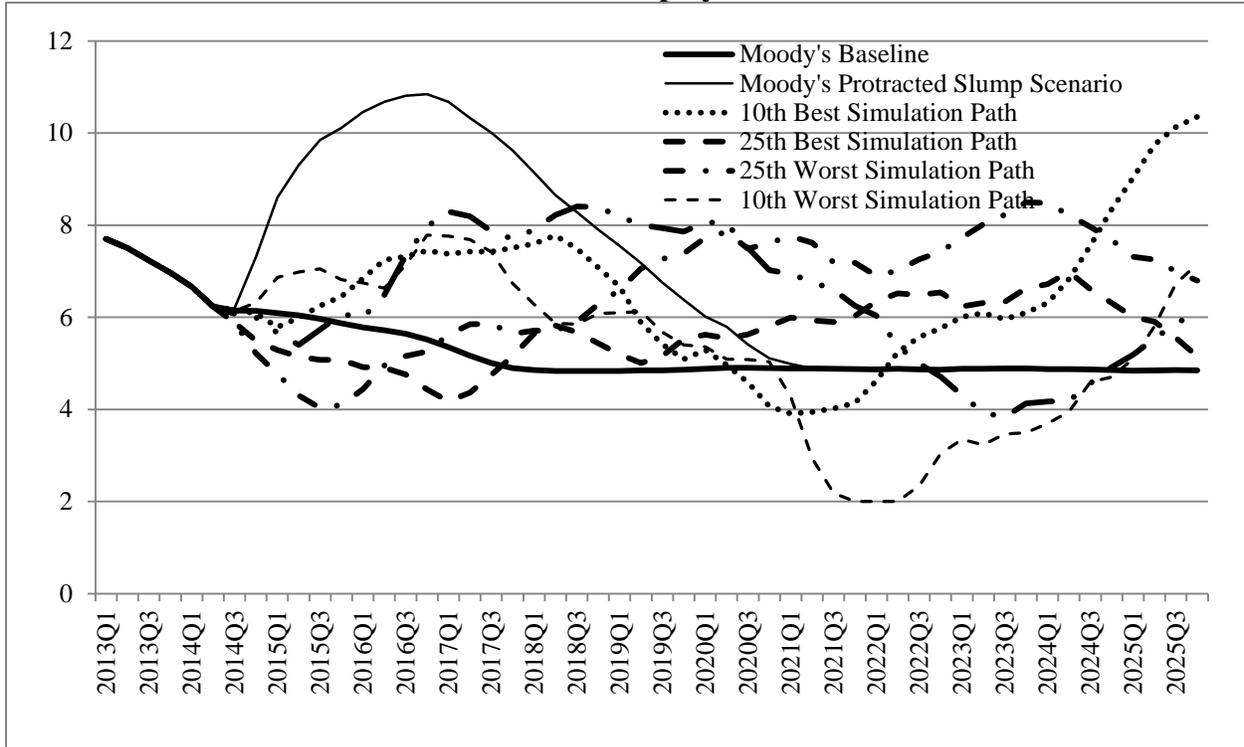


Exhibit D-4 shows the forecasted unemployment rate under different scenarios.

Exhibit D-4: Paths of the Future National Unemployment Rate in Different Scenarios



The projected performance of the Fund corresponding to each selected scenario described above is presented in Section V of this Review.

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Appendix E
Loss Severity Model

Appendix E: Loss Severity Model

This appendix describes the loss severity model used in the FY 2014 Review. One of the primary sources of variation in the MMI Fund performance has been the loss severity experienced on loans that terminate as claims. In the case of a single loan, this loss, expressed as a percentage of the remaining unpaid principal balance at the claim date, is referred to as the “loss rate” or the “loss severity rate.”⁵⁴ This Review analyzes the loss rate by modeling the probability of the type of disposition used along with modeling the loss rate for each of these types of disposition. Section I summarizes the specification and estimation approaches in the model, Section II describes the explanatory variables used in this model, and Section III presents the estimation results.

I. Model Specification and Estimation Approaches

Typically, when an FHA-endorsed loan terminates as a claim, the property is “conveyed” to FHA and FHA makes a payment to the lender to settle the claim and acquires the underlying property—that is, it becomes real estate owned, or REO. The claim payment FHA makes to the servicer, known as the “acquisition cost,” consists of three components: the outstanding unpaid principal balance on the loan; the foregone interest advanced by the servicer as a result of the loan default; and legal and administrative costs paid by the servicer associated with foreclosure, including any expenses associated with the cost of repairing or maintaining the property prior to the conveyance of the property. We thus have:

$$\textit{Acquisition Cost} = \textit{Unpaid Principal Balance} + \textit{Foregone Interest} + \textit{Foreclosure Expense}$$

Following acquisition, FHA attempts to sell the property, sometimes at a reduced price in order to assist low-income prospective homebuyers to buy a house. During the period when the property is held by FHA, but not yet sold, FHA incurs various holding costs associated with maintenance, repairs, tax payments and expenses incurred in preparing the property for sale. Upon sale of the collateral property, FHA receives the sale price less any sales expenses. In sum, the loss amount is the net amount that FHA incurs from this process:

$$\textit{Loss Amount} = \textit{Acquisition Cost} + \textit{Holding Cost} - \textit{Sale Price} + \textit{Sale Expense}$$

FHA permits pre-foreclosure sales (PFS) as an alternative to the foreclosure process. In pre-foreclosure sales, the property is sold by the borrower without the foreclosure process being

⁵⁴ This definition is different from HUD’s definition, which uses the acquisition cost as the denominator of the loss rate.

completed or even started in some cases. Instead of acquiring the foreclosed house, FHA directly pays the loss amount claimed by the lender. The loss amount of a pre-foreclosure sale case is reported as the acquisition cost to FHA.

For both foreclosures and pre-foreclosure sales, the loss amount expressed as a percentage of the unpaid principal balance is referred to as the loss rate:

$$\text{Loss Rate} = \frac{\text{Loss Amount}}{\text{Unpaid Principal Balance}}$$

Exhibit E-1 shows the distribution of different types of FHA claim terminations. Conveyance refers to the foreclosure procedure discussed above, wherein the property is conveyed to FHA after foreclosure is completed. This is the most common type of claim.

There was a significant volume of note (non-performing loan) sales from FY 2003 through FY 2006. In these cases, the remaining foreclosure procedures or house sales were avoided by FHA. Since September 2012, FHA resumed the note sales activities and completed a few deals. Note Sales are mainly policy-driven and highly unpredictable, so we use recent and imminent sales as the basis for “modeling” them. For forecast purposes, we use a note sale override to incorporate recent and imminent note sale transactions, and we do not model them as a continuing program. We use the recent actual loss severity rates as indicated in Appendix B.

FHA changed its servicing guide in 2013 to allow foreclosure without conveyance. This consists of a third-party-sale (TPS) during the foreclosure auction. A third party, instead of FHA, acquires the property directly from the foreclosure auction. This process allows FHA to avoid the process of property disposition after conveyance and any associated holding costs. This procedure splits a foreclosure into either a conveyance or a TPS.

Exhibit E-1: Percentages of Claim Termination Types by Fiscal Year

Claim Year	Open Foreclosure	Conveyance (REO)	Note Sales	Third Party Sale (TPS)	Pre-Foreclosure Sale (PFS)
1999	0.00	94.87	0.11	0.00	5.02
2000	0.00	95.06	0.09	0.00	4.85
2001	0.01	95.02	0.01	0.00	4.97
2002	0.00	94.33	0.00	0.00	5.66
2003	0.00	86.74	8.34	0.00	4.92
2004	0.00	85.57	8.41	0.00	6.02
2005	0.02	83.28	9.79	0.00	6.91
2006	0.04	89.33	2.83	0.00	7.80
2007	2.67	90.33	0.00	0.00	7.00
2008	3.86	89.51	0.00	0.06	6.57
2009	1.34	88.82	0.00	0.04	9.79
2010	1.08	83.55	0.31	0.00	15.06
2011	0.83	75.69	1.16	0.00	22.32
2012	0.94	71.60	1.33	2.18	23.94
2013	1.70	56.84	17.88	4.97	18.62
2014	2.15	45.65	23.45	16.59	12.16

Exhibit E-2 presents the average loss severity rates for the combined Foreclosure (REO and TPS) and Pre-foreclosure sale claims by termination fiscal year over the 1991-2013 periods. The loss rate has increased from FY 2003, reaching a record level of 62.19 (61.96 in Exhibit E-20 percent in FY 2009).

Exhibit E-2: Historical Loss Rates

Termination Year	Loss Rate
1991	44.07%
1992	44.04%
1993	43.12%
1994	43.84%
1995	44.17%
1996	43.83%
1997	44.15%
1998	43.12%
1999	40.54%
2000	36.60%

Termination Year	Loss Rate
2001	32.71%
2002	31.14%
2003	32.39%
2004	35.36%
2005	37.46%
2006	42.36%
2007	51.46%
2008	60.32%
2009	61.96%
2010	57.11%

Termination Year	Loss Rate
2011	58.92%
2012	61.80%
2013	55.13%
2014	38.13%

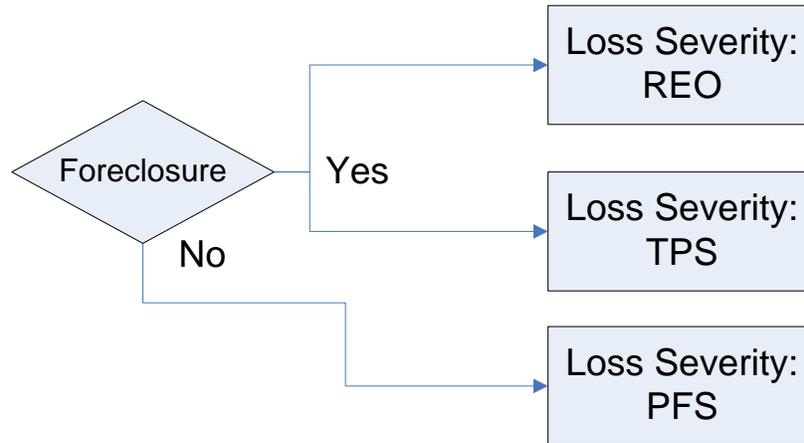
A. Specification of the Loss Severity Model

As described above, there are several components of the total loss amount, and each component can be influenced by a number of factors. Foregone interest depends on the interest rate on the mortgage and on the length of the default-to-claim lag. Foreclosure expenses can vary depending on whether a judicial foreclosure process is used that can lengthen the foreclosure process time and this varies by state. Repair expenses may be a function of the financial condition of the borrowers, which we proxy by their credit scores. Sale prices are influenced by the house price appreciation since origination and by the prevailing local housing market conditions during the default and property disposition periods. Several components of the loss amount involve expenses that are fixed across foreclosed properties. Hence, loans with relatively smaller unpaid principal balances are more likely to realize higher loss rates since the denominator of the loss ratio will be smaller relative to these fixed components of the numerator.

As shown in Exhibit E-1, the distribution between conveyance/TPS (foreclosure) and pre-foreclosure sales (PFS) was relatively stable through FY 2009. Due to recent widespread house price declines and the higher volume of defaults, starting from FY 2010, the foreclosure claim process was lengthened and foreclosure claims were delayed, while the pre-foreclosure sales process was relatively stable. Since FY 2010, the pre-foreclosure sales share increased significantly. Moreover, the proceeds recovered from conveyance and pre-foreclosure sales differ significantly. To accommodate more accurate estimates of loss rates, we adopted a two-stage model: (1) a model to account for the choice between a pre-foreclosure sale (PFS) and

foreclosure and (2) their different loss rates conditional on being PFS or foreclosure. The following flowchart describes the major components of the FY 2014 Review loss severity model.

Exhibit E-3: Choice-Based Loss Severity Model



First, we estimate the probability of that a claim is settled by the foreclosure process versus the pre-foreclosure sale (PFS) process. The foreclosure outcome is further split into conveyance (REO) and Third Party Sale (TPS). To model this choice event, we used a standard binary logit model to predict the probability that a property would be conveyed to FHA. The functional form is given by the following logit equation.

$$\text{logit}(x) = \ln \frac{\pi(x_i)}{1 - \pi(x_i)} = \beta_0 + \sum \beta_k X_{ki} + e_i$$

Where x_i denotes that the outcome of the claim i is PFS;
 X_{ki} is the value of explanatory variable k for claim i ;
 the sum is over k ;
 and e_i is the error term.

For claim i , the PFS and foreclosure probability are calculated as the following:

$$\begin{aligned} \text{Probability of PFS} &= \frac{e^{\beta_0 + \sum \beta_k X_{ki}}}{1 + e^{\beta_0 + \sum \beta_k X_{ki}}} \\ \text{Probability of Foreclosure} &= 1 - \text{Probability of PFS}. \end{aligned}$$

Further, the probability of foreclosure is split into REO and TPS, where the TPS probability is assumed to gradually increase in the future from its current level to a long-term average (*TPS_Perm_Ratio*).

$$\begin{aligned}
 & \text{Probability of TPS} \\
 &= \text{Probability of Foreclosure} \\
 & * \left(\text{TPS_Init_Ratio} + (\text{TPS_Perm_Ratio} - \text{TPS_Init_Ratio}) \right. \\
 & \left. * \frac{\min(N_{qtr}, \text{TPS_N})}{\text{TPS_N}} \right).
 \end{aligned}$$

And the REO probability is

$$\text{Probability of REO} = \text{Probability of Foreclosure} - \text{Probability of TPS}.$$

Second, we estimate the loss rate as a function of all the same explanatory factors used in the above model of the choice of foreclosure or PFS depending on whether the claim disposition is by foreclosure or PFS. That is, there are two loss rate equations. The loss rate is not bounded between zero and one. It can be more than one hundred percent if the loss amount is more than the unpaid principal balance; it can also be less than zero if the sale price of the house is more than enough to cover the unpaid principal balance and all associated costs to FHA. The loss rate appears to be a smooth and continuous function of the underlying explanatory variables. We used ordinary least squares (OLS) regression to estimate the parameters of the two loss rate models. Conditional on whether the claim is an REO or a pre-foreclosure sale, the specification of the regression model is:

$$\begin{aligned}
 \text{LossRate}_{REO}(X_i | i \in REO) &= f(X_i) + \varepsilon_i \\
 \text{LossRate}_{PFS}(X_i | i \in PFS) &= g(X_i) + \varepsilon_i
 \end{aligned}$$

where $\text{LossRate}(X_i)$ is the realized loss rate of claim i , which emanates from REO (conveyance) or PFS;

X_i includes all explanatory variables for claim i ;
and ε_i is the error term.

For TPS, because we currently do not have enough data to estimate an econometric model, we applied a haircut to the REO loss rate to get the TPS loss rate:

$$\text{LossRate}_{TPS} = \text{LossRate}_{REO}(1 - \text{TPS_LR_haircut}).$$

Thus, the estimated loss rate in the fund is the weighted average of loss rates depending on different claim types.

$$\begin{aligned}
 \text{Loss Rate} &= \text{Probability of REO} * \text{LossRate}_{REO} + \text{Probability of TPS} * \text{LossRate}_{TPS} \\
 &+ \text{Probability of PFS} * \text{LossRate}_{PFS}.
 \end{aligned}$$

where the probabilities of foreclosure and PFS are predicted from the loss selection model, the probability of REO vs. TPS follows the model described above, and *LossRate* (X_i) is predicted from one of the two conditional loss rate models above, as appropriate.

In this year's Review, we used the following parameters for the TPS-related loss rate calculation:

Third Party Sale initial ratio: 25%;
Number of quarters before convergence to the long-term ratio: 8;
Third Party Sale long-term ratio: 25%;
Third Party Sale loss rate haircut from REO loss rate: 22.5%.

B. Estimation Sample

The sample used to estimate the loss severity model for the FY 2014 Review consists of loan-level data from the FHA single-family data warehouse for the categories conveyance and pre-foreclosure sales. The available data cover the period from the first quarter of FY 1975 to the second quarter of FY 2014. The FHA loss mitigation program was initiated in 1996 and fully implemented in 2002. Due to the recent lengthening of foreclosure timelines and also the lengthening of the time from REO to the sale of the property (due to the market being saturated with foreclosure sales), for the selection model our analysis used the sample with origination years from 1990 Q1 to 2012 Q4 and termination years from FY 2006 through FY 2013 Q4 by including open foreclosure cases to represent the foreclosure backlog issue. We also included accelerated claims and claims without conveyance (TPS) as foreclosure sales. The final sample used for the selection estimation includes 693,428 loans claimed over these past years. Exhibit E-4 shows the impact of the various sample exclusions for the choice model and the two loss rate models.

Many claims associated with foreclosures in FY 2013Q3 or later have not yet been fully resolved, so the conveyance loss rate for these claims will be biased by including the faster property disposition cases, which tend to incur lower losses. REO claims after FY 2013Q2 are excluded from the REO loss rate estimation sample. Given the differences in the disposition process and the recording process between conveyance and pre-foreclosure sale claim types, the REO loss rate model used the sample with termination years from FY 2000 through FY 2013Q2, while the PFS loss rate model used the sample with termination years from FY 2000 through FY 2013 Q4. Only the claim cases with completed claim data for which loss rates have been recorded were included in the sample. The data used in these two loss rate models are processed using the same exclusion rules as for the selection model. The final samples used for the estimation of the REO and PFS loss rate models included 810,129 and 124,695 claimed loans, respectively.

Exhibit E-4: Claim Counts for the Three Loss Severity Models

	Loan Count
Original Total Claims or Open Foreclosure	1,742,273
Drop cases with UPB = 0 or loan age < 0	214,738
Drop cases with missing LTV data	190,614
Observations Surviving First Round of Exclusions	1,336,921
Drop with other miscellaneous data quality issues	427
Observations Eligible for Severity Models	1,336,494
Observations Eligible for Selection Model (FY 2006Q1 – FY 2013Q4, all the open foreclosure, conveyance, accelerated claims, non-conveyance claims without conveyance of title, pre-foreclosure cases)	693,428
Observations Eligible for Conveyance Loss Rate Model (FY 2000Q1 – FY 2013Q2, all conveyance cases)	810,129
Observations Eligible for PFS Loss Rate Model (FY 2000Q1 – FY 2013Q4, all pre-foreclosure cases)	124,695

II. Explanatory Variables

There are six main categories of explanatory variables applied in the loss severity analysis:

- Fixed initial loan characteristics, including mortgage product type, non-owner occupied;
- Fixed initial borrower characteristics, including borrower credit scores and indicators of the source of downpayment assistance where relevant;
- Fixed property characteristics, including number of units;
- Fixed property state characteristics, including indicators of judicial foreclosure process and whether deficiency judgments are allowed;
- Dynamic variables based entirely on loan information, including mortgage age, scheduled amortization of the loan balance relative loan size, current loan-to-value and default episode duration; and
- Dynamic variables derived by combining loan information with economic time series such as house price appreciation rates (e.g., as it influences the REO sales price) and interest rates (e.g., as used to indicate the refinance incentive).

Most explanatory variables used in the loss severity model are the same as those used in the loan status transition models. Please refer to Appendix A for the definition of these variables. Only a non-owner occupied indicator, a deficiency judgment state indicator are created especially for the loss severity model. We now describe the rationale for these two latter variables.

Non-owner occupied indicator: An investor owned property house seems to be is viewed as being more risky, because the owner is not living in the house and is therefore less likely to maintain the property and the tenants have little no incentive to maintain it.

Deficiency Judgment State: Some states allow lenders to sue borrowers for the lender's losses after foreclosure. We used the website <http://www.foreclosurelaw.org/> to identify such "deficiency judgment" states. The possibility of recourse is expected to reduce losses, all else equal.

III. Estimation Results

Exhibit E-5 presents the regression coefficients, the corresponding Chi-square and t-statistics.

Exhibit E-5: Regression Results

Description	name	value	Foreclosure/PFS Selection			Loss Rate Given Conveyance			Loss Rate Given PFS		
			Spline	Coefficient	Chi-Sq	Spline	Coefficient	t-value	Spline	Coefficient	t-value
Intercept				-6.4412	1421.89		0.5823	37.59		-0.1773	-19.95
Current LTV	ltv_current1	spline function	1	3.3312	4619.55	0.5	0.3446	13.01	1.2	0.6839	156.59
	ltv_current2		>1.0	2.1374	1632.01	0.9	1.0566	216.02	>1.2	0.2326	45.50
	ltv_current3		cap @1.3			1.2	0.4074	74.26			
	ltv_current4		>1.2			>1.2	0.0000				
Relative Loan Size	loansize1	spline function	100	0.0235	6811.19	50	-0.0105	-89.90	90	-0.0024	-47.81
	loansize2		180	0.0097	2373.42	100	-0.0051	-227.28	140	-0.0012	-45.90
	loansize3		>180	0.0064	128.20	180	-0.0017	-76.64	>140	0.0000	
	loansize4		>180			>180	0.0003	2.38			
House price appreciation local level	hpa2y	linear function								-0.0024	-0.55
	hpa2y_1	spline function	-0.2	6.0004	1317.95	0.2	-0.5176	-119.31			
	hpa2y_2		0.1	1.6164	802.81	>0.2	-0.3318	-22.02			
hpa2y_3	>0.1	3.2109	1203.33								
Cross Section HousePrice Volatility	sigma_parm_a	linear function					40.4971	36.70		33.5529	22.85
Loan age	age1	spline function	20	-0.0154	275.00	35	0.0098	182.07	15	0.0077	47.76
	age2		>20	0.0110	191.98	45	0.0177	84.86	30	0.0085	66.13
	age3		>45			>45	0.0126	65.65	>30	0.0153	75.36
1-quarter Default Episode Duration Flag	def_episode	x=0/1					0.1132	85.72			
Default Episode Duration	def_epi_dur1	spline function	4	-0.4119	11936.85	6	0.0160	59.39	6	0.0250	86.78
	def_epi_dur2		9	-0.1413	1954.42	15	0.0114	64.53	15	0.0191	56.59
	def_epi_dur3		>9	-0.0954	660.73	>15	-0.0028	-6.67	>15	-0.0050	-3.85
Mortgage Rate Spread	ms_spread									-0.0255	-14.27
Prior Modification Flag	prior_mod	x=0/1		0.1619	152.82		0.1133	81.78		0.1058	61.93
Relative Unemployment Rate	rel_ue	linear function					0.0367	21.58			
Credit Score	credit_score	linear function	580	0.0024	74.35					-0.0001	-16.30
	credit_score1	spline function	680	0.0076	2807.52	680	-0.0004	-42.40			
	credit_score2		>680	0.0051	644.57	>680	-0.0001	-3.94			
Flag for No Credit Score Returned	credit_score000	x=0/1		0.0702	13.14		0.0200	15.39		0.0123	5.35
Flag for Missing Credit Score	credit_score999	x=0/1		-0.2341	248.48		-0.0003	-0.30		-0.0087	-5.21
Judicial State Flag	judicial	x=0/1		0.5538	4509.58		0.0906	131.31		0.0058	5.98
Deficiency State Flag	deficiency	x=0/1		0.7425	4364.85		-0.0626	-57.05		-0.0253	-19.64
UNICON Score Flag	unicon_score	x=0/1					0.0266	26.53		-0.0270	-17.49
Refinance Flag	refinance	x=0/1					0.1002	106.75		0.0963	88.86
Non-profit Gift Downpayment Assistance Flag	dpa_nonprof	x=0/1					0.0519	59.27		0.0371	30.96
Number of Units (2-4) Flag	flag_24	x=0/1					0.1362	63.97		0.1485	43.92
Non-Owner Occupied Flag	noown_occ	x=0/1					-0.0384	-9.31		-0.0326	-5.64
Fixed 15-year Product Flag	prod_25	x=0/1					0.2170	64.97			
Model Fit Statistics			Somer's D	0.5670		Adj. R ²	0.4067		Adj. R ²	0.5656	
			c	0.7840							

Appendix F
FHA Volume Model

Appendix F: FHA Volume Model

This Appendix describes our model for projecting future FHA endorsement volumes. This model is used to project future FHA loan volumes that are sensitive to alternative economic scenarios. Our FHA volume model specification includes two sub-models. First, we estimated mortgage market dollar volumes separately for purchase and refinance loans at the national level, excluding home equity loans and second liens. Second, we estimated the share of FHA fully-underwritten refinance volume as a percentage of the national refinance volume. This year the future SR originations are endogenously simulated by the results of FHA SR prepayment transition estimation. Therefore the SR origination volume equals the SR prepayment counts occurring during the immediate preceding quarter.

In our model, the national purchase volume responds to house prices and prior volumes, while the national refinance volume responds to prior refinance volumes, the moving average of national purchase volumes, house prices and mortgage and Treasury interest rates. The FHA fully underwritten refinance volume, stated as a share of the national refinance volume, is a function of the GSE and FHA refinance spread.

The FHA purchase volume is derived from the national purchase volume based on an assumed share scheme as shown in Exhibit F-5. The forecasted share starts out from the observed FY2014Q1 to FY2015Q4 purchase share of 16 percent and it reduces to 15 percent for FY2016Q1 and beyond. The 15 percent long-term market share is an estimate based on future government policies and the private mortgage market roles. If alternatives to FHA lending completely rebound to their historical average within the next few years, FHA market shares would be lower than assumed here.

For model estimation, we used data from FY 1990Q2 through FY 2014Q2.

I. Volume Model Specification

We use the following notation:

Variables:

V = National Volume (\$ millions)

F = FHA Volume (\$ millions)

R = Interest Rate

H = National Home Price Index

Q = Quarter Indicator (as 0/1 dummy variables for each quarter)

T = 1 after FY 2006; 0 otherwise

G = Spread of FHA and GSE Refinance Rates

Subscripts:

t = time index (quarterly)

k = index for coefficients or quarters

Superscripts:

P = Purchase Mortgages

R = Refinance Mortgages

S = Streamline Refinance Mortgage (FHA)

1 = 1-year Treasury

10 = 10-year Treasury

m = Mortgage

$\alpha, \beta, \theta, \lambda, \gamma, \varphi$ and ω are coefficients to be estimated.

We estimated the set of equations shown below by Ordinary Least Squares:

$$\ln V_t^P = \alpha_0 + \sum_{k=1}^3 \alpha_k Q_k + \sum_{k=1}^3 \beta_k \ln V_{t-k}^P + \varphi \ln \left(\frac{H_t}{H_{t-4}} \right) + \omega \ln(H_t) \quad (1)$$

$$\ln V_t^R = \alpha_0 + \beta \ln V_{t-1}^R + \sum_{k=0}^4 \gamma_k R_{t-k}^m + \lambda (R_t^{10} - R_t^1) + \varphi \ln \left(\frac{H_t}{H_{t-4}} \right) + \omega \ln \left(\frac{\sum_{k=0}^3 V_{t-k}^P}{4} \right) \quad (2)$$

$$\ln \frac{F_t^R}{V_t^R} = \alpha_0 + \beta G_t + \theta T \quad (3)$$

Equation (1) implies that the nation’s volume of purchase mortgages is a seasonally adjusted function of its volume in the last quarter, the housing price index (HPI) and the yearly house price appreciation (HPA). Equation (2) says that the nation’s volume of new refinance mortgages is a function of its lagged volume, mortgage rates at the current quarter and over the last four quarters, the spread between the 10- and 1-year Treasury rates, the moving average of the national purchase volumes and yearly HPA. The third equation says that the share of FHA’s non-SR volume of the nation’s refinance mortgages is a function of the spread between the GSE and FHA refinance rates and whether the date is after FY2006. As mentioned above, the transition equations include a transition to SR mortgages, so there is no need to have a separate model projection.

II. Historical Data

When estimating the volume model, we used historical data from public sources as well as the FHA data warehouse as of end of June, 2014. Exhibit F-1 details the data sources.

Exhibit F-1: Sources and Description of Variables

Variables	Source	Description
1-year Treasury rate	Federal Reserve Bank of St. Louis FRED® Economic Data ^a	1-Yr Constant Maturity Securities
10-year Treasury rate	Federal Reserve Bank of St. Louis FRED® Economic Data	10-Yr Constant Maturity Securities
Mortgage rate	Federal Reserve Bank of St. Louis FRED® Economic Data	Mortgage Rates Primary Market: 30-Year Commitment Rate - Fixed Rate, National
GSE & FHA Refinance Spread	Federal Reserve Bank of St. Louis FRED® Economic Data FHA Mortgage Letter	Mortgage Rates Primary Market: 30-Year, Spread between GSE and FHA mortgage interest rate, Mortgage Insurance Premium
House Price Index	FHFA	FHFA Purchase Only Home Price Index (1991Q1 = 100), National
Market originations	MBA ^b	National Mortgage Origination, Purchase and Refinance, 1-4 Family, July 2013
FHA originations	FHA data warehouse	FHA loans separated into purchase, SR, refinance

^a Federal Reserve Bank of St. Louis FRED® Economic Data, <http://research.stlouisfed.org/fred2/>

^b Mortgage Bankers Association, <http://www.mbaa.org/ResearchandForecasts/ForecastsandCommentary>

III. Regression Results

Exhibits F-2 through F-4 provide the details of the regression results for Equations (1) – (3), respectively. We retained several statistically insignificant coefficients to show more general model specifications and to make the model forecasts more sensitive to macroeconomic forecasts.

Exhibit F-2: Ln(National Purchase Dollar Volume) Regression [Equation (1)]

Variable Name	Coefficient	t-statistic	Pr > t
Ln(National Purchase Volume), lagged 1 qtr	0.438	3.96	0.0002
Ln(National Purchase Volume), lagged 2 qtr	0.142	1.21	0.231
Ln(National Purchase Volume), lagged 3 qtr	0.286	2.73	0.0076
Ln(National Home Price Index)	0.035	0.45	0.6528
Ln (Home Price at t / Home Price t-4)	1.369	3.58	0.0006
Winter	-0.138	-2.6	0.0111
Spring	0.240	3.75	0.0003
Summer	0.165	2.93	0.0043
Intercept	1.357	2.99	0.0036
Number of observations = 93			
Adj R-Sq = 0.9198			
Durbin-Watson = 1.87			

Exhibit F-3: Ln(National Refinance Dollar Volume) Regression [Equation (2)]

Variable Name	Coefficient	t-statistic	Pr > t
Ln(National Refi Volume), lagged 1 qtr	0.659	8.41	<.0001
Ln((lag 1 to 4 National Purchase Volume)/4)	0.422	3.16	0.0022
Mortgage rate at t	-0.581	-8.17	<.0001
Mortgage rate, lagged 1 quarter	-0.25	-2.16	0.0337
Mortgage rate, lagged 2 quarters	0.757	6.64	<.0001
Mortgage rate, lagged 3 quarters	-0.296	-2.71	0.0081
Mortgage rate, lagged 4 quarters	0.255	3.29	0.0015
Spread between 10-Yr and 1-Yr	0.012	0.4	0.69
Ln (Home Price at t / Home Price t - 4)	1.112	1.96	0.0531
Intercept	-0.394	-0.4	0.6889
Number of observations =93			
Adj R-Sq = 0.9500			
Durbin-Watson = 2.31			

Exhibit F-4: Ln(FHA Fully Underwritten Refinance (FUWR) Volume /National Market Refinance Volume) Regression [Equation (3)]

Variable Name	Coefficient	t-statistic	Pr > t
Dummy = 1 if FY>2006	2.596	8.82	<.0001
FHA - GSE Refinance Spread	-1.230	-2.46	0.0157
Intercept	-4.389	-8.88	<.0001
Number of observations = 96			
Adj R-Sq = 0.4499			
Durbin-Watson = 0.17			

IV. Model Adjustments

Due to the nature of stochastic simulation, certain paths could cause large deviation of FHA’s non-SR volume and project the volume higher than its historical performance range, which is 65 percent of the purchase volume, and even exceed the FHA fully-underwritten purchase volume. One adjustment we implemented is that FHA’s non-SR volume is capped at 70 percent of predicted FHA fully-underwritten purchase volume through FY 2014Q3 to FY 2021.

As described in section I, the dollar volume forecast of the FHA for-purchase mortgages follows Equation (1). But we also applied some assumptions regarding FHA’s share of the national purchase market as shown in Exhibit F-5.

Exhibit F-5: Assumed FHA Purchase Volume Share

Fiscal Years	FHA Purchase Volume Share of National Purchase Volume
2014Q3-2015Q4	16%
2016Q1-2021Q4	15%

FHA’s share of the purchase market is assumed to be 16 percent starting from FY2014Q3 and is reduced to 15 percent in the following years and maintain at this level in the future.

Based on Moody’s baseline scenario, the predicted product volumes are shown in Appendix C, Exhibit C-1. The refinance volumes decline sharply in response to Moody’s forecasted rapid rise in interest rates, resulting in some temporal variability in the product volumes and their relative shares. Note that with this demand model, we have made the volume projections endogenous, responding to alternative economic scenarios.

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Appendix G

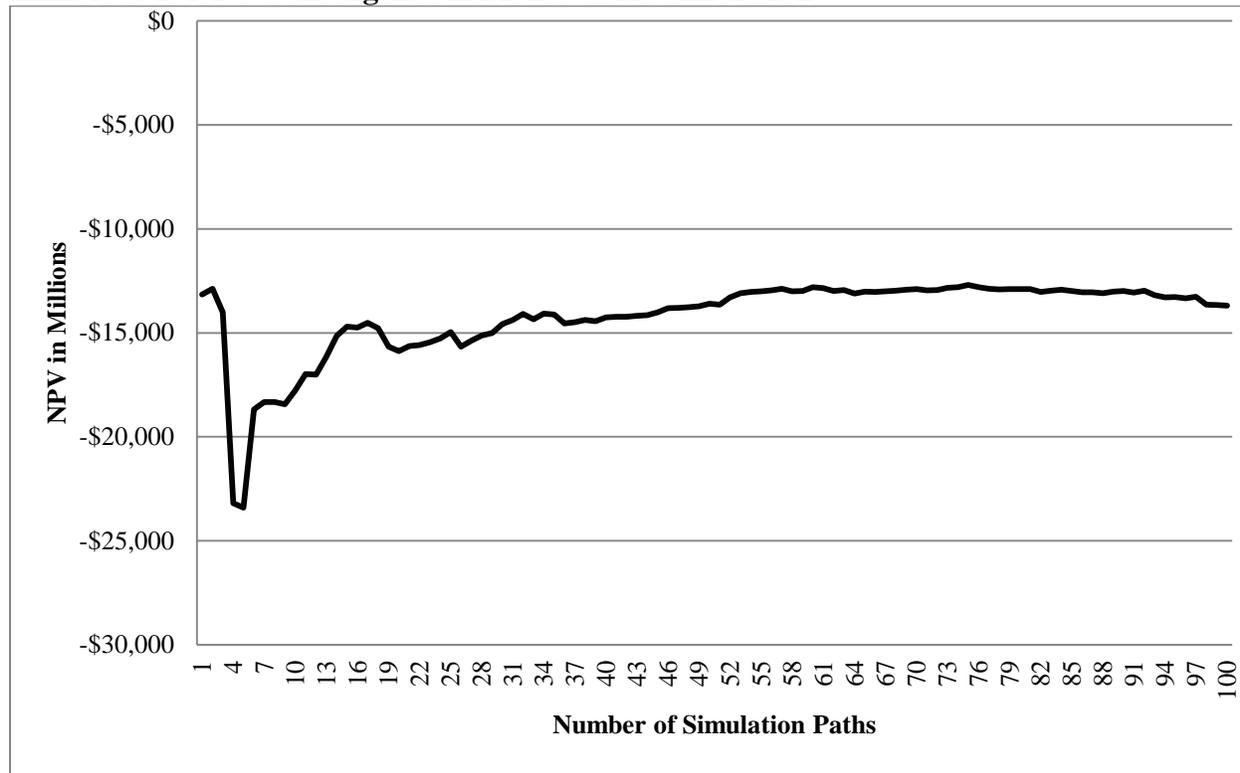
Stochastic Simulation

Appendix G: Stochastic Models

This appendix describes the stochastic processes assumed for the economic variables used in the Monte Carlo simulations of the FHA Actuarial Review 2014. Starting from the 2012 Review, we interpret the expected present value as the present value (PV) of expected cash flows from a wide variety of possible paths of house price appreciation rates (HPA), interest rates and unemployment rates. This interpretation is consistent with the industry best practice for pricing and measuring risks of mortgage portfolios. The concept (in terms of the “Monte Carlo” technique that we use in this Review) is to project a number of equally likely paths of HPA and interest rates, compute the PV of the projected cash flows for each path and, since each path is equally likely, compute the average PV over all the paths as the expected present value.

We selected 100 simulated paths for the Monte Carlo simulations. With these 100 paths, the present value of the future cash flows converged to a stable value. This converged value is the expected present value of future cash flows. If we were to randomly draw a number of sets of 100 paths, we infer that the results will be essentially the same expected PV of the future cash flows among individual sets. We obtain the economic value of the Fund by adding this expected present value to the capital resources of the Fund. Using more paths would increase the computation time required to conduct simulations with diminishing improvement of precision. Exhibit G-1 demonstrates the convergence of the Monte Carlo simulation. After about the 75th path the expected PV of future cash flows does not change measurably.

Exhibit G-1: NPV Convergence in Monte Carlo Simulation



The economic variables modeled herein as stochastic include:

- 1-year Treasury rates,
- 10-year Treasury rates,
- 30-year fixed rate mortgage (FRM) rates,
- FHFA national house price index (HPI), and
- Unemployment rates.

These stochastic variables were modeled to project the “real world” or “physical” measure and hence were estimated using historical data.⁵⁵ This approach is appropriate for the Actuarial Review because the simulated rates are designed to approximate the actual future values. Since all transition probability models were estimated using the historically observed interest rate, house price appreciation and unemployment rates, estimating interest rates and other economic variables using the real-world measure, versus risk-neutral measures used for security trading purposes, is consistent with this approach.

⁵⁵ For valuing options, so-called “risk-neutral” future paths of interest rates are developed that permit estimation of option values based on observed option prices and the prices of the underlying asset upon which the options are based. These paths do not have any resemblance to historical movements in interest rates and are not suitable for the actuarial review purpose.

I. Historical Data

A. Interest Rates

With the high inflation rate caused by the global oil crisis in the late 1970's, interest rates rose to a historically high level in early 1980's. Since then, the Federal government shifted its monetary policy from managing interest rates to managing the money supply. Interest rates generally decreased since this policy shift. Exhibit G-3 shows historical interest rates since 1962. The 1-year Treasury rate (cmt01) was around 2% in 1962 and increased steadily to its peak of 16.31% in 1981 Q3. After that, it followed a decreasing trend and reached an all-time low of 0.11% in 2011 Q4. Also shown are the 10-year Treasury rate (cmt10), the 30-year fixed rate mortgage rate (mrate) and the 1-year LIBOR rate (LIBOR_1y).

Exhibit G-2: Historical Interest Rates (%)

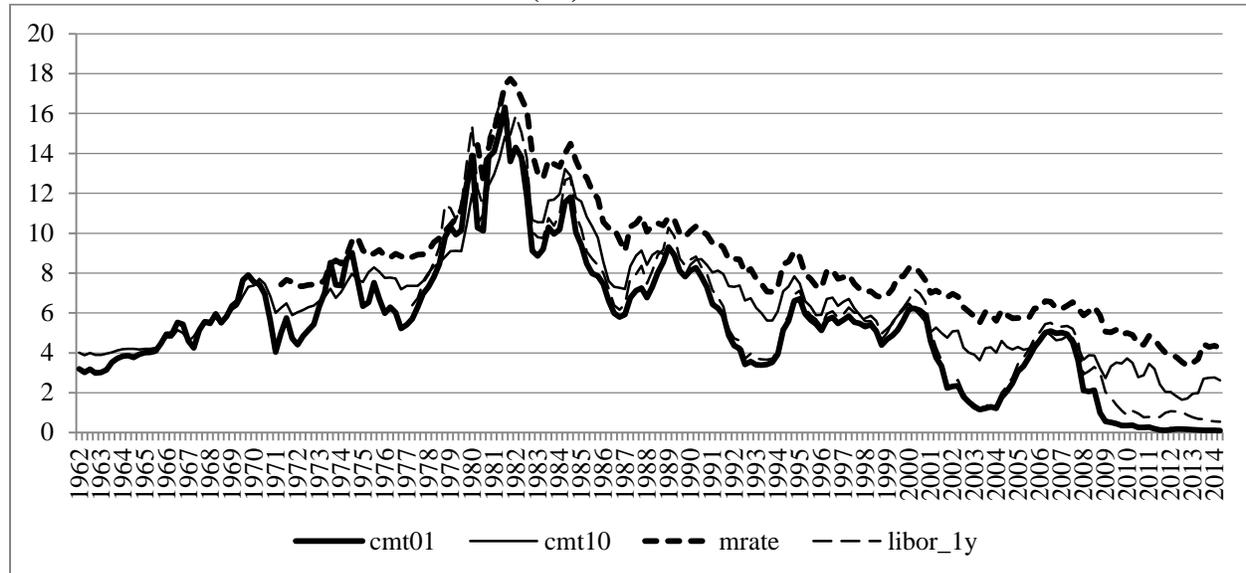
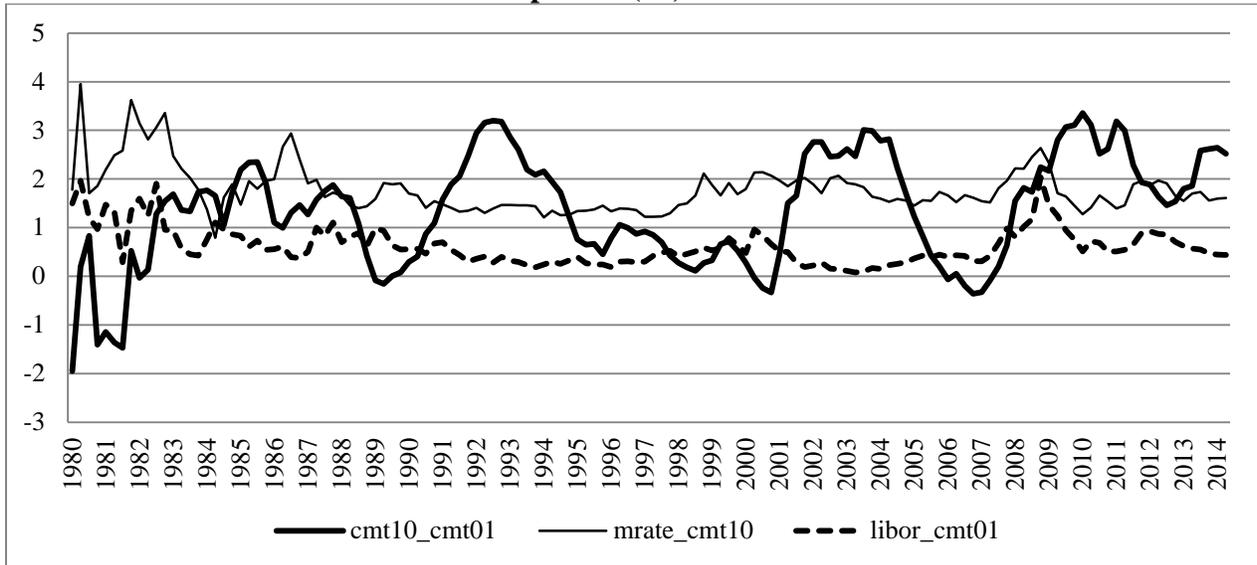


Exhibit G-3 shows historical interest rate spreads, including the spread between the 10-year and the 1-year Treasury rate, the spread between the 30-year mortgage rate and the 10-year Treasury rate and the spread between the 1-year LIBOR and the 1-year Treasury rate. The spread between the 10-year and 1-year Treasury rates appears to have long cycles and the spread is not always positive. However, the spread of the mortgage rate over the 10-year Treasury rate and the spread of LIBOR over the 1-year Treasury rate are always positive, reflecting the premium for credit risk.

Exhibit G-3: Historical Interest Rate Spreads (%)



B. House Price Appreciation Rates

The national house price appreciation rate (HPA) is derived from FHFA repeat sales house price indexes (HPIs) of purchase-only (PO) transactions. The PO Index provides a reliable measure of housing market conditions, since it is based on repeat sales at market prices and does not use any appraised values.

Since PO HPI index started from 1991, we used the HPI data from 1991 Q1 through 2014 Q1 to build our model. The HPA series being modeled is defined as

$$HPA_t = \ln\left(\frac{HPI_t}{HPI_{t-1}}\right)$$

Exhibit G-4 shows the national HPI and quarterly HPA from 1991 Q1 to 2014 Q1. The long-term average quarterly HPA is around 0.796% (3.22% annual rate).

The PO HPI increased steadily before 2004, and the quarterly appreciation rate was around 1.14%. Then house prices rose sharply starting 2004. The average quarterly house price appreciation rate was 1.88% during the subprime mortgage expansion period from 2004 to 2006, and reached its peak of 2.59% in 2005 Q2. After 2006, the average growth rate became negative. Exhibit G-5 shows the average quarterly HPA (at annual rates) by selected historical time periods.

Exhibit G-4: Historical National HPI and HPA

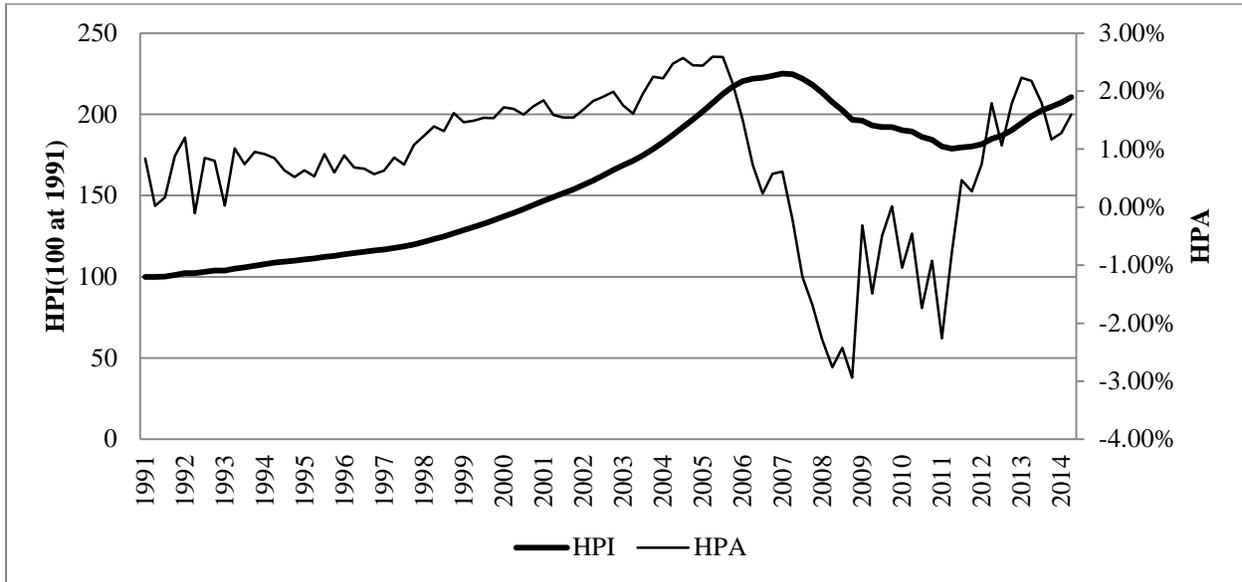


Exhibit G-5: Average Quarterly HPA by Time Span

Period	Average Quarterly HPA
1991 – 2003	1.13%
2004 – 2006	1.88%
2007 – 2010	-1.21%
2011 – 2013	0.87%

II. 1-Year Treasury Rate

In this section, we present selected historical statistics on the one-year Treasury rate, describe the model we used in our simulations and report the parameter estimates and their standard errors. Exhibit G-6 shows the summary statistics of the historical 1-year Treasury rates for two periods, one from 1962 and the other from 1980.

Exhibit G-6: Statistics for the 1-Year Treasury Rates

Statistics	Since 1980	Since 1962
Mean	5.28%	5.51%
Standard Deviation	3.78%	3.29%
Max	16.31%	16.31%
95- Percentile	13.62%	11.70%
90- Percentile	10.14%	9.82%
50- Percentile	5.51%	5.46%
10- Percentile	0.27%	0.57%
5- Percentile	0.15%	0.18%
Min	0.10%	0.10%

We used a GARCH(1,1) parameterization to model the 1-Year Treasury rate (r_1) and estimated it using data from 1980 Q1 to 2014 Q2. The process takes the following form:

$$r_{1,t} = A + B * r_{1,t-1} + \sigma_t dZ_1 \tag{1}$$

where Z_1 is an independent Wiener random process with distribution $N(0,1)$,

and where the variance (σ) of the residual term follows a GARCH(1,1) process:

$$\sigma_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \gamma_1 r_{1,t-1} \tag{2}$$

where ε is the error term, which equals $\sigma_t dZ_1$ from equation (1).

Full information maximum likelihood (FIML) was used to estimate the parameters in equations 1 and 2. The results are presented in Exhibit G-7.

Exhibit G-7: Estimation Results for 1-Year Treasury Rate Model

Parameter	Estimate	Std Dev	t-value	prob>t
A	1.09E-04	3.15E-04	0.3	0.728
B	0.981	0.01	93.4	0.000
β_0	-2.01E-07	8.21E-08	-2.4	0.014
β_1	0.150	0.08	1.8	0.075
β_2	0.573	0.11	5.1	0.000
γ_1	1.65E-04	5.41E-05	3.0	0.002
Adj. R ²	0.958			

The model based on these parameters is used to simulate FY 2014 Q3 and future 1-year Treasury rates. When the simulation is implemented, the “constant” term A is actually calibrated to a different value to match Moody’s base line forecast in each forecasted quarter. The values were chosen so that the median value among 100 simulations matches Moody’s July 2014 baseline forecast of the 1-year Treasury rate quarter by quarter. We applied the same procedure for the “constant” terms in the interest rate and HPA equations below.

Note that Moody’s July forecast only covers the period until 2044 Q4. After 2044, we repeated Moody’s last 4-quarter forecasts for all remaining quarters. All the other interest rates and HPA series are expanded to the year 2100 using the same methodology. A lower bound of 0.01 percent was applied to the simulated future 1-year Treasury rates to avoid negative rates in the simulation.

III. 10-Year Treasury Rate

The 10-year Treasury rate is modeled by adding a stochastic spread term to the 1-year rate. We estimate the dynamics of the spread between the 10-year Treasury rate and the 1-year Treasury rate from the historical data. The spread term is assumed to depend on the one-year rate and the lagged value of the spread term and a random component. The model for the spread is:

$$s_{10,t} = \alpha_{10,t} + \beta_{10}r_{1,t} + \gamma_{10}s_{10,t-1} + \varepsilon_{10,t} \tag{3}$$

where $s_{10,t}$ is the spread between the 10-year and 1-year Treasury rates and $r_{1,t}$ is 1-year Treasury rate. The variance of the residual term follows an ARCH (1) process:

$$\sigma_t^2 = \beta_0 + \beta_1\varepsilon_{t-1}^2 \tag{4}$$

FIML was used to estimate the parameters. The estimated parameters are shown in Exhibit G-8.

Exhibit G-8: Estimation Results for 10-Year Treasury Rate Spread Model

Parameter	Estimate	Std Dev	t-value	prob>t
α_{10}	0.004	0.001	2.82	0.006
β_{10}	-0.023	0.014	-1.68	0.095
γ_{10}	0.840	0.045	18.89	0.000
β_0	1.30E-05	2.89E-06	4.47	0.000
β_1	0.527	0.275	1.92	0.058
Adj. R ²	0.833			

We used the estimated parameters to simulate the spread between the 10-year and 1-year Treasury rates, and added the simulated spread to the simulated 1-year Treasury rate. Then we adjusted the constant term $\alpha_{10,t}$ to calibrate the series such that the median value among 100 simulated paths matched Moody’s July 2014 base forecast of the 10-year Treasury rate quarter by quarter (and with the same logic of expanding the forecast series to year 2100). We also set a floor value of 0.01 percent to the simulated 10-year Treasury rates.

IV. Mortgage Rate

We modelled the mortgage rate by first modelling the spread between the mortgage rate and the 10-year Treasury rate and then adding the spread back to the 10-year rate. The process for the spread is assumed to be:

$$s_{m,t} = \alpha_{m,t} + \beta_{1m}r_{1,t} + \beta_{2m}r_{1,t-1} + \beta_{3m}s_{10,t} + \beta_{4m}s_{m,t-1} + \varepsilon_{m,t} \tag{5}$$

where $s_{m,t}$ is the spread between the mortgage rate and the 10-year Treasury rate, $r_{1,t}$ is the 1-year Treasury rate, and $s_{10,t}$ is the spread between the 10-year and 1-year Treasury rates. The variance of the residual term follows a GARCH (1,1) process:

$$\sigma_t^2 = \beta_0 + \beta_1\varepsilon_{m,t-1}^2 + \beta_2\sigma_{t-1}^2 \tag{6}$$

FIML was used to estimate the parameters in equations (5) and (6). The estimated parameters are shown in Exhibit G-9.

Exhibit G-9: Estimation Results for the Mortgage to 10-Year Treasury Rate Spread Model

Parameter	Estimate	Std Dev	t-value	prob>t
α_m	0.005	0.001	5.28	0.000
β_{1m}	-0.178	0.031	-5.71	0.000
β_{2m}	0.170	0.031	5.56	0.000
β_{3m}	-0.052	0.017	-3.02	0.003
β_{4m}	0.737	0.049	14.94	0.000
β_0	2.26E-07	1.26E-07	1.79	0.075
β_1	0.129	0.064	2.02	0.046
β_2	0.792	0.069	11.49	0.000
Adj. R ²	0.615			

We used the estimated parameters to simulate the spread between the mortgage rate and the 10-year Treasury rate, and added the simulated spread to the simulated 10-year Treasury rate to obtain the mortgage rate. Then we adjusted the “constant” term $\alpha_{m,t}$ to calibrate the series such that the median value among 100 simulated paths matched Moody’s July 2014 base forecast of the mortgage rate quarter by quarter. As with the other interest rates, we also set a floor value at 0.01 percent to the simulated mortgage rate.

V. House Price Appreciation Rate (HPA)

A. National HPA

We specified the national HPA to depend on its own lags, seasonal dummy variables, the level of short rates and on various spreads and their lags. After considerable experimentation, the model we adopted was:

$$HPA_t = \mu_t + \beta_1 HPA_{t-1} + \beta_2 HPA_{t-2} + \beta_3 r_{1,t} + \beta_4 r_{1,t-1} + \beta_5 s_{10,t} + \beta_6 s_{10,t-1} + \beta_7 s_{m,t} + \beta_8 s_{m,t-1} + \sigma_{h,t} dZ_h \tag{7}$$

where, $r_{1,t}$ is the 1-year Treasury rate,
 $s_{10,t}$ is the spread between the 10-year and 1-year Treasury rates,
 $s_{m,t}$ is the spread between mortgage rate and 10-year Treasury rate, and
 Z_h is the independent Wiener random process with distribution $N(0,1)$.

The variance of the residual term follows a GARCH (1,1) process:

$$\sigma_{h,t}^2 = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 \sigma_{h,t-1}^2 \tag{8}$$

The lags and variable inclusions were determined by achieving appropriate coefficient signs and significance, and overall model fit. FIML was used to estimate parameters in equations (7) and (8). The results are shown in Exhibit G-10.

Exhibit G-10: Estimation Results for the National HPA Model

Parameter	Estimate	Std Dev	t-value	prob>t
μ	0.002	0.002	1.01	0.311
β_1	0.632	0.094	6.72	0.000
β_2	0.231	0.093	2.47	0.014
β_3	-0.086	0.085	-1.01	0.313
β_4	0.059	0.083	0.71	0.477
β_5	-0.173	0.119	-1.46	0.145
β_6	0.150	0.122	1.23	0.219
β_7	0.014	0.174	0.08	0.938
β_8	0.074	0.158	0.47	0.640
γ_0	2.86E-07	4.51E-07	0.63	0.526
γ_1	0.372	0.156	2.39	0.017
γ_2	0.649	0.109	5.96	0.000
Adj. R ²	0.654			

We used these parameters to simulate future HPAs from 2014 Q3. Also, we calibrated the mean of HPA (μ_t in the equation) by matching the median value across 100 simulated paths to Moody’s July base forecast. Moody’s July forecast extends only to year 2044 Q4, so again we repeat the last four quarters for the remaining terms.

B. Geographic dispersion

The MSA-level HPA forecasts were based on Moody's forecast of local and the national HPA forecasts. Specifically, at each time t , there is a dispersion of HPAs between the i^{th} MSA and the national forecast:

$$Disp_{i,t}^{Base} = (HPA_{i,t}^{Base} - HPA_{national,t}^{Base})$$

This dispersion forecast under Moody's base case was preserved for all local house price forecasts under individual future economic paths. That is, for economic path j , the HPA of the i^{th} MSA at time t was computed as:

$$HPA_{i,t}^j = (HPA_{national,t}^j + DISP_{i,t}^{Base})$$

This approach retains the relative current housing market cycle among different geographic locations and it allows us to capture the geographical concentration of FHA's current endorsement portfolio. This approach is also consistent with Moody's logic in creating local market HPA forecasts relative to the national HPA forecast under alternative economic scenario forecasts.⁵⁶ We understand this approach is equivalent to assuming perfect correlation of dispersions among different locations across simulated national HPA paths, which creates a systematic house price decreasing during economic downturns and vice versa during booms. Due to Jensen's Inequality, this tends to generate a more conservative estimate of claim losses of the Fund.

VI. Unemployment Rate

A. National Unemployment Rate

In 2012, we added the unemployment rate in the transition models and we included it this year as well. In our unemployment rate model, the unemployment rate depends on the prior unemployment rates, house prices, mortgage rates and Treasury rates.

We used quarterly data from CY 1975 to CY 2014Q1 to estimate the national unemployment rate. The model we adopted was:

$$ue_t = \mu_t + \beta_1 ue_{t-1} + \beta_2 ue_{t-2} + \beta_3 r_{1,t} + \beta_4 r_{m,t} + \beta_5 HPA_t + \varepsilon_t \quad (9)$$

where, $r_{1,t}$ is the 1-year Treasury rate,

$r_{m,t}$ is the 30-year mortgage rate,

HPA_t is the annualized house price growth rate at the national level, and

ue_t is the unemployment rate.

⁵⁶ The dispersion of each MSA remains constant among all alternative Moody's forecast scenarios.

Exhibit G-11: Estimation Results for the National Unemployment Rate Model

Parameter	Estimate	Std Dev	t-value	prob>t
μ	0.185	0.095	1.95	0.053
β_1	1.502	0.064	23.35	0.000
β_2	-0.574	0.061	-9.47	0.000
β_3	-1.482	0.461	-3.22	0.002
β_4	-0.049	0.020	-2.48	0.014
β_5	0.072	0.023	3.11	0.002
Adj. R ²	0.981			

From the simulated interest rates and house prices, we applied the parameters shown in Exhibit G-11 to calculate the corresponding national unemployment rate. Based on historical statistics, the national unemployment rate was capped at 20% with a floor at 2%.

B. Geographic Dispersion

Following the same logic that we applied to the MSA-level HPA forecasts, we first obtained the dispersion of unemployment rates between the i^{th} MSA level and the national level from Moody's July base-case forecast at each time t :

$$Disp_{i,t}^{Base} = (ue_{i,t}^{Base} - ue_{national,t}^{Base})$$

This dispersion forecast was preserved for all local unemployment rate forecasts under each individual future economic path. That is, for economic path j , the unemployment rate of the i^{th} MSA at time t was computed as:

$$ue_{i,t}^j = (ue_{national,t}^j + DISP_{i,t}^{Base})$$

For the simulation, we capped the unemployment rate at local level at 30% with a floor at 1%.

VII. Dynamic Simulation

Similar to last year, we still use a dynamic simulation methodology to handle certain path dependencies. Dynamic simulation uses a random number process to assign each loan to a single status at any point in time, depending on the relative probabilities among feasible transitions during that particular time period. Previously, simulated loans were represented as having probabilities of all possible statuses in the future.

The use of dynamic simulation improves the speed of the simulation and allows greater flexibility for the transition probabilities to be path-dependent. The FY 2012 Review used a series of dummy variables for default duration: 1, 2, 3, and 4-or-more quarters. This approach was adopted to reduce the dimensions of the matrix of transition probabilities to be generated during the forecast involving product and transition types, mortgage age and duration. Allowing varying default probabilities for more than 4 quarters would have imposed an unmanageable

simulation time to achieve convergence. Thus, all loans in default status at duration 4 or higher at the start of a quarter were assigned to the same duration category. This implied that the delinquency duration impact was constant for durations 4 and higher, and the level the function had attained by duration 4 was applied to all higher durations. The dynamic simulation approach removes this limitation and allows default duration to increase without bound.

Under the previous static simulation approach, we had to retain all the previous period's transition probabilities to forecast a loan's future performance to capture the path-dependent nature of asymmetric impact of the economic condition prior to a point in time. Under the dynamic simulation approach, a random number was drawn from the uniform distribution over the range [0,1], using the transition probabilities as cut points. If the random number is within the cutoffs for a given transition, the particular transition was assigned to the loan with a value of 1 to that transition. That is, the loan is assumed to transit to that status. We assign a value of zero to all other transitions, since they were not selected by the random draw.

For example, if the transition probability from current to default is 0.02 and the cut points are, say, 0 and 0.02, and if the random number drawn is 0.68, then we assign a value of zero to this transition, meaning that this transition does not take place. However if the random number drawn was 0.0152, the assigned value is 1, meaning that the transition occurs. We only need to keep the transition record when it happens, because other transitions are known to be represented by zeros. That is, a loan was assigned to one particular simulated status with certainty. In this way, we can reduce the information to be carried forward along each simulation path, thus improving the efficiency of the simulations. This efficiency allows the removal of the default duration limitation that was previously imposed.

Dynamic simulation can decrease the computation time and reduce the information needs to be carried along each simulation path. We can gain a large efficiency advantage using this method when using a large loan-level dataset. However, the accuracy of the economic value forecast produced by dynamic simulation depends on both the size of the loan population and the number of simulations. A disadvantage is that in order to have precision, a large number of loans need to be tracked. As the MMI Fund forward portfolio is composed of millions of loans, the precision and stability of the results is not a concern. Nevertheless, we adopted the antithetic variates⁵⁷ method to improve the convergence efficiency in the dynamic simulation. With our final model, the variation of the economic value of the expected net present value of the MMI Fund due to random number variation is now less than \$0.05 billion.

⁵⁷ Glasserman, P., (2003), *Monte Carlo Methods in Financial Engineering*, Springer.

Appendix H

Econometric Results

Conditional Claim Rates		All Mortgages by Credit Subsidy Endorsement Cohort																												
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.03	0.96	2.78	4.93	7.30	6.29	4.36	3.27	2.88	2.56	2.54	2.19	1.69	1.59	1.21	1.03	0.81	0.55	0.37	0.27	0.19	0.15	0.13	0.09	0.06	0.09	0.08	0.06	0.05	0.08
1985	0.02	0.83	3.24	6.00	5.37	4.02	3.38	3.06	3.06	2.98	2.83	2.01	1.94	1.65	1.16	1.21	0.73	0.55	0.38	0.32	0.22	0.15	0.11	0.16	0.15	0.10	0.12	0.08	0.03	0.06
1986	0.01	0.44	1.71	2.16	2.03	1.85	1.66	1.57	1.77	1.85	1.51	1.47	1.25	1.09	0.97	0.64	0.48	0.43	0.41	0.28	0.19	0.20	0.14	0.17	0.20	0.23	0.15	0.12	0.11	0.11
1987	0.01	0.36	1.03	1.25	1.28	1.28	1.22	1.37	1.38	1.19	1.20	1.06	0.95	0.82	0.48	0.41	0.41	0.38	0.29	0.20	0.16	0.14	0.24	0.23	0.27	0.19	0.18	0.14	0.18	0.05
1988	0.01	0.39	1.13	1.54	1.81	1.85	2.25	2.44	2.03	1.96	1.77	1.62	1.37	0.84	0.70	0.64	0.63	0.44	0.38	0.23	0.28	0.30	0.30	0.33	0.30	0.28	0.23	0.25	0.08	0.05
1989	0.01	0.33	1.09	1.62	1.99	2.67	2.95	2.46	2.36	1.95	1.74	1.54	0.96	0.83	0.73	0.72	0.56	0.47	0.35	0.32	0.36	0.47	0.45	0.43	0.34	0.25	0.28	0.08	0.08	0.04
1990	0.01	0.29	1.08	1.75	2.57	2.87	2.35	2.40	2.06	1.81	1.55	1.01	0.79	0.76	0.71	0.55	0.49	0.47	0.46	0.40	0.61	0.54	0.45	0.53	0.36	0.30	0.10	0.13	0.09	0.05
1991	0.01	0.30	1.16	2.04	2.61	2.31	2.47	2.17	1.86	1.66	1.03	0.86	0.77	0.75	0.61	0.46	0.40	0.46	0.45	0.47	0.59	0.46	0.54	0.44	0.39	0.18	0.17	0.16	0.13	0.06
1992	0.00	0.21	0.77	1.26	1.40	1.76	1.70	1.57	1.35	0.90	0.69	0.62	0.57	0.49	0.41	0.31	0.37	0.39	0.37	0.49	0.46	0.50	0.52	0.53	0.28	0.30	0.35	0.26	0.25	0.25
1993	0.00	0.16	0.60	0.98	1.47	1.43	1.29	1.07	0.65	0.52	0.48	0.49	0.39	0.32	0.27	0.28	0.32	0.45	0.45	0.42	0.59	0.63	0.79	0.31	0.36	0.38	0.28	0.29	0.27	0.21
1994	0.00	0.22	0.74	1.32	1.58	1.48	1.14	0.72	0.59	0.53	0.53	0.44	0.35	0.30	0.27	0.35	0.53	0.48	0.42	0.59	0.67	0.74	0.42	0.45	0.41	0.35	0.35	0.32	0.31	0.32
1995	0.01	0.29	1.36	2.29	2.73	2.41	1.71	1.39	1.62	1.50	1.17	0.96	0.78	0.81	0.89	1.19	1.06	0.85	1.06	1.08	1.23	0.58	0.56	0.69	0.52	0.48	0.47	0.39	0.44	0.32
1996	0.00	0.31	1.35	2.29	2.31	1.67	1.45	1.63	1.61	1.29	1.04	0.86	0.89	0.94	1.21	1.10	1.15	1.22	1.36	1.36	0.63	0.73	0.71	0.64	0.49	0.49	0.40	0.42	0.36	0.32
1997	0.01	0.39	1.61	2.38	1.99	2.01	2.27	2.15	1.80	1.42	1.23	1.27	1.25	1.47	1.33	1.25	1.41	1.67	1.56	0.90	0.93	0.92	0.83	0.75	0.63	0.58	0.58	0.54	0.44	0.41
1998	0.01	0.34	1.15	1.28	1.35	1.65	1.83	1.65	1.40	1.14	1.15	1.23	1.52	1.44	1.37	1.61	1.67	1.70	0.89	0.92	0.82	0.68	0.52	0.46	0.37	0.38	0.30	0.22	0.26	0.15
1999	0.01	0.32	0.86	1.27	1.85	2.16	1.98	1.57	1.30	1.28	1.38	1.69	1.74	1.65	1.82	1.99	1.88	1.07	0.96	0.85	0.66	0.53	0.45	0.33	0.29	0.21	0.19	0.18	0.16	0.13
2000	0.01	0.49	1.99	4.05	4.80	4.07	3.32	2.84	2.89	2.76	3.19	2.83	2.51	2.80	2.99	2.98	1.87	1.58	1.58	1.19	1.04	0.87	0.62	0.62	0.46	0.45	0.47	0.33	0.32	0.22
2001	0.01	0.43	1.83	3.61	3.77	3.25	2.76	2.69	2.58	3.16	3.06	2.77	2.99	3.38	3.21	1.93	1.78	1.50	1.20	0.86	0.78	0.53	0.42	0.39	0.30	0.27	0.23	0.15	0.13	0.10
2002	0.01	0.47	2.08	2.82	2.67	2.41	2.41	2.44	2.99	2.80	2.73	3.09	3.40	3.39	2.06	1.84	1.69	1.28	1.04	0.88	0.66	0.57	0.47	0.42	0.35	0.28	0.29	0.21	0.21	0.14
2003	0.01	0.66	1.57	1.76	1.68	1.80	1.94	2.57	2.34	2.58	3.07	3.69	3.62	2.18	1.94	1.70	1.29	1.05	0.92	0.69	0.63	0.48	0.45	0.39	0.31	0.27	0.22	0.19	0.17	0.10
2004	0.12	0.88	1.44	1.69	2.07	2.23	2.79	2.59	2.83	3.37	4.34	4.26	2.56	2.32	2.02	1.54	1.28	1.13	0.85	0.76	0.64	0.56	0.49	0.38	0.35	0.30	0.26	0.22	0.16	0.12
2005	0.11	0.76	1.81	2.63	3.21	3.91	3.56	3.79	4.56	5.43	5.19	3.30	2.98	2.77	2.16	1.77	1.50	1.16	0.99	0.82	0.70	0.62	0.47	0.48	0.37	0.32	0.24	0.20	0.17	0.12
2006	0.02	0.62	2.21	3.71	5.23	4.61	4.94	6.24	6.85	6.44	4.08	3.67	3.41	2.57	2.08	1.68	1.22	1.01	0.82	0.69	0.51	0.43	0.32	0.29	0.24	0.16	0.14	0.10	0.08	0.06
2007	0.02	0.81	3.18	5.78	4.97	5.94	8.96	9.13	8.49	5.37	4.97	4.62	3.47	2.79	2.33	1.67	1.39	1.09	0.89	0.75	0.51	0.47	0.38	0.32	0.21	0.17	0.14	0.09	0.07	0.05
2008	0.01	0.69	3.43	4.15	5.31	8.64	9.17	8.42	5.16	4.75	4.29	3.39	2.66	2.19	1.60	1.31	1.05	0.84	0.67	0.51	0.45	0.36	0.30	0.23	0.18	0.15	0.13	0.08	0.07	0.04
2009	0.01	0.52	1.35	2.16	3.89	4.70	4.50	2.91	2.67	2.39	1.82	1.47	1.22	0.88	0.77	0.65	0.55	0.46	0.37	0.33	0.29	0.25	0.19	0.16	0.14	0.12	0.09	0.07	0.06	0.05
2010	0.01	0.23	0.72	1.52	2.18	2.40	1.69	1.66	1.58	1.29	1.07	0.93	0.69	0.60	0.53	0.45	0.39	0.31	0.29	0.26	0.23	0.20	0.17	0.15	0.14	0.11	0.09	0.08	0.06	0.05
2011	0.01	0.21	0.66	1.14	1.54	1.24	1.31	1.27	1.08	0.89	0.79	0.61	0.53	0.45	0.41	0.36	0.29	0.28	0.25	0.23	0.19	0.17	0.16	0.15	0.12	0.11	0.10	0.09	0.07	0.06
2012	0.01	0.14	0.50	0.95	0.93	0.99	1.02	0.89	0.76	0.69	0.51	0.44	0.37	0.32	0.28	0.25	0.22	0.20	0.18	0.17	0.14	0.13	0.12	0.11	0.10	0.10	0.08	0.08	0.06	0.05
2013	0.01	0.16	0.64	0.85	0.98	1.03	0.90	0.81	0.71	0.55	0.49	0.42	0.37	0.33	0.27	0.26	0.24	0.21	0.18	0.16	0.15	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.04
2014	0.01	0.24	0.81	1.24	1.44	1.34	1.28	1.22	0.97	0.98	0.84	0.69	0.67	0.46	0.44	0.42	0.39	0.32	0.29	0.28	0.24	0.25	0.19	0.17	0.18	0.16	0.14	0.10	0.07	0.05
2015	0.01	0.25	1.06	1.72	1.71	1.67	1.61	1.34	1.26	1.12	1.03	0.91	0.75	0.69	0.58	0.53	0.47	0.42	0.42	0.34	0.30	0.25	0.27	0.19	0.24	0.13	0.12	0.10	0.06	0.04
2016	0.01	0.41	1.56	2.04	2.06	2.03	1.77	1.58	1.44	1.33	1.26	1.02	0.98	0.82	0.70	0.68	0.64	0.54	0.48	0.43	0.38	0.31	0.28	0.25	0.20	0.14	0.10	0.09	0.05	0.05
2017	0.02	0.45	1.45	1.86	1.99	1.78	1.72	1.57	1.44	1.25	1.08	1.07	0.92	0.87	0.74	0.68	0.73	0.70	0.57	0.44	0.41	0.39	0.35	0.29	0.25	0.16	0.13	0.11	0.08	0.06
2018	0.01	0.41	1.33	1.82	1.64	1.60	1.49	1.49	1.37	1.11	1.10	1.01	1.00	0.83	0.71	0.75	0.69	0.59	0.50	0.44	0.42	0.38	0.33	0.28	0.22	0.15	0.12	0.10	0.08	0.04
2019	0.01	0.39	1.49	1.59	1.67	1.60	1.59	1.55	1.25	1.30	1.11	1.06	1.00	0.91	0.90	0.81	0.66	0.57	0.54	0.51	0.46	0.37	0.33	0.31	0.22	0.18	0.14	0.09	0.07	0.04
2020	0.01	0.44	1.30	1.69	1.82	1.80	1.77	1.51	1.47	1.31	1.23	1.09	1.02	1.00	1.02	0.81	0.75	0.66	0.66	0.59	0.52	0.48	0.41	0.31	0.24	0.21	0.19	0.15	0.09	0.05
2021	0.02	0.40	1.27	1.66	1.75	1.79	1.54	1.56	1.46	1.32	1.21	1.17	1.21	1.07	0.82	0.78	0.77	0.68	0.64	0.56	0.52	0.46	0.37	0.30	0.24	0.21	0.16	0.12	0.08	0.04

Conditional Prepayment Rates	All Mortgages by Credit Subsidy Endorsement Cohort																													
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.28	1.49	21.02	29.04	13.53	10.96	11.97	12.69	19.36	20.62	22.08	9.25	10.39	9.03	10.60	11.57	6.33	5.66	6.19	6.17	5.25	4.18	6.52	2.25	2.39	3.76	1.69	2.70	1.82	9.08
1985	0.35	12.11	25.56	11.83	9.64	11.94	14.26	24.54	25.87	25.27	9.52	11.24	9.80	12.20	13.00	7.77	6.89	7.93	7.89	6.60	5.03	9.31	2.80	3.06	6.19	2.29	2.45	1.67	1.68	2.00
1986	0.58	4.05	2.98	3.53	4.95	6.05	15.63	28.29	27.19	8.07	12.31	10.46	17.14	19.08	10.34	12.64	17.04	19.15	15.14	11.05	13.98	6.39	5.01	6.35	3.71	3.96	3.63	3.95	3.22	1.12
1987	0.31	1.12	1.96	3.17	3.75	9.25	21.04	22.44	6.96	10.74	9.32	16.24	19.53	10.43	13.63	19.56	24.62	18.81	13.98	15.87	7.92	6.54	6.89	5.26	5.41	5.10	5.26	4.00	1.17	0.92
1988	0.41	1.67	3.52	5.22	15.68	28.85	27.29	8.21	12.43	10.39	16.22	18.74	10.83	12.99	17.08	19.33	16.18	12.34	15.33	7.11	5.36	5.17	3.78	4.81	3.47	4.07	3.30	1.65	1.32	0.74
1989	0.50	2.23	4.63	16.80	31.66	29.78	8.53	12.86	10.48	16.99	19.43	10.94	13.24	18.44	20.46	17.80	13.47	16.32	7.30	5.30	4.91	3.51	4.77	3.56	4.00	3.36	1.95	1.54	1.09	0.72
1990	0.40	2.14	10.78	33.31	32.19	8.54	13.27	10.55	17.69	20.48	11.00	13.97	20.20	23.06	19.60	14.65	19.93	8.40	6.22	5.93	4.16	4.91	4.15	4.32	4.00	2.06	1.57	1.13	0.99	0.70
1991	0.39	5.99	28.52	31.64	7.88	13.23	10.68	18.67	21.35	11.01	15.43	21.95	26.09	21.70	16.12	19.60	9.36	6.58	6.59	4.21	4.77	3.99	4.27	3.81	2.10	1.56	1.27	0.90	0.81	0.68
1992	0.62	9.29	17.32	6.54	11.59	10.08	19.05	22.55	11.34	17.48	25.05	32.64	25.67	19.14	16.18	12.11	8.78	6.49	5.58	4.97	4.81	5.49	4.05	2.16	1.61	1.13	1.03	0.85	0.75	0.64
1993	1.37	6.64	4.70	8.54	8.13	14.65	18.82	10.73	16.89	25.65	39.45	29.21	21.91	17.37	12.68	9.75	7.85	6.84	5.99	5.84	6.60	5.17	2.80	2.20	1.60	1.25	1.23	1.09	0.84	0.73
1994	0.89	2.92	7.22	7.52	13.47	16.19	9.94	15.79	22.53	36.86	28.11	21.75	17.02	12.83	9.83	7.76	6.57	6.17	6.43	6.96	5.20	2.88	2.12	1.64	1.47	1.37	1.10	0.98	0.85	0.65
1995	1.91	9.86	9.89	21.66	20.88	10.51	18.26	24.98	33.48	28.14	23.21	18.62	14.06	9.07	6.02	5.15	4.55	4.47	5.13	4.50	3.13	2.61	1.94	1.72	1.45	1.27	1.16	1.04	0.86	0.75
1996	0.62	4.26	18.77	20.87	10.01	18.24	25.36	36.36	29.66	24.37	19.01	14.19	9.68	6.79	5.52	4.97	5.02	5.86	5.17	3.52	2.55	2.07	1.88	1.63	1.44	1.26	1.18	1.00	0.85	0.65
1997	0.98	14.96	24.47	11.25	21.87	25.89	34.94	28.89	24.05	19.13	14.33	9.82	6.28	4.86	4.32	4.34	5.22	4.94	3.74	2.78	2.15	1.89	1.80	1.53	1.35	1.30	1.03	0.93	0.76	0.73
1998	2.04	10.69	7.63	16.38	24.43	40.82	32.46	26.40	19.69	14.53	9.99	7.89	6.02	5.33	5.43	7.13	5.80	4.34	3.10	2.38	2.15	1.84	1.69	1.53	1.37	1.25	1.17	1.02	0.86	0.66
1999	0.96	3.53	13.40	22.97	40.01	32.06	26.71	19.57	14.23	9.93	8.15	6.30	5.69	5.93	8.00	6.21	4.35	3.23	2.40	2.14	1.95	1.67	1.60	1.45	1.28	1.12	1.08	0.90	0.82	0.68
2000	0.97	29.20	35.43	38.03	30.22	26.17	20.16	15.39	9.75	6.54	4.71	3.79	4.17	5.30	5.17	4.13	3.09	2.33	2.09	1.95	1.74	1.57	1.37	1.25	1.15	1.12	0.91	0.83	0.68	0.56
2001	5.72	22.50	46.22	34.25	27.78	20.13	14.06	9.78	8.65	5.94	4.94	5.23	7.56	5.94	4.13	2.74	2.16	1.95	1.75	1.51	1.42	1.33	1.21	1.17	1.04	0.97	0.81	0.65	0.64	0.50
2002	4.72	38.17	32.01	27.23	19.79	14.91	10.17	9.36	6.76	5.71	6.31	9.48	6.82	4.33	2.95	2.20	2.03	1.86	1.61	1.43	1.40	1.24	1.17	1.07	0.96	0.85	0.72	0.68	0.61	0.48
2003	11.38	22.13	25.24	18.03	13.13	8.84	9.11	7.26	6.80	8.25	13.33	8.21	5.10	3.37	2.59	2.24	2.11	1.89	1.72	1.62	1.53	1.40	1.27	1.18	1.04	0.91	0.86	0.72	0.62	0.51
2004	7.72	21.14	16.94	12.65	7.87	7.46	6.11	5.80	7.92	13.48	8.05	5.43	3.49	2.75	2.42	2.20	2.02	1.85	1.76	1.60	1.51	1.36	1.23	1.11	1.01	0.96	0.80	0.74	0.67	0.45
2005	7.20	11.80	11.00	7.59	7.29	5.67	5.28	7.66	13.53	6.87	3.77	2.26	1.67	1.50	1.40	1.25	1.12	1.11	0.99	0.94	0.88	0.81	0.74	0.63	0.59	0.52	0.47	0.45	0.39	0.28
2006	1.43	7.74	9.11	12.30	7.54	6.32	8.93	14.85	7.51	3.77	1.98	1.46	1.23	1.06	0.97	0.85	0.87	0.76	0.76	0.70	0.63	0.56	0.52	0.48	0.43	0.37	0.36	0.34	0.28	0.25
2007	1.44	11.39	15.90	8.07	5.88	7.95	13.42	7.84	3.96	1.99	1.47	1.38	1.14	0.89	0.88	0.76	0.77	0.70	0.69	0.65	0.56	0.49	0.50	0.43	0.37	0.33	0.34	0.28	0.25	0.24
2008	2.13	22.53	12.56	8.10	11.43	17.70	9.35	4.67	2.50	1.84	1.68	1.48	1.15	1.00	0.94	0.91	0.83	0.77	0.71	0.66	0.60	0.53	0.49	0.45	0.42	0.37	0.32	0.32	0.27	0.24
2009	6.14	9.06	7.98	15.10	21.69	9.74	6.36	3.89	3.02	2.76	2.43	2.01	1.71	1.62	1.48	1.44	1.31	1.25	1.11	0.99	0.95	0.86	0.75	0.70	0.61	0.59	0.53	0.49	0.45	0.37
2010	1.86	5.32	10.64	17.24	10.22	8.15	5.45	4.25	3.78	3.45	2.91	2.35	2.09	1.89	1.77	1.62	1.56	1.38	1.23	1.18	1.05	0.96	0.88	0.78	0.71	0.67	0.63	0.57	0.49	0.42
2011	0.61	9.01	16.41	13.12	11.67	7.86	6.04	5.43	4.89	4.18	3.33	2.84	2.42	2.23	1.99	1.84	1.65	1.47	1.38	1.25	1.12	1.04	0.95	0.88	0.80	0.75	0.70	0.61	0.55	0.44
2012	1.07	9.93	11.09	10.81	7.86	6.45	5.89	5.38	4.76	3.89	3.31	2.88	2.64	2.34	2.10	1.89	1.68	1.56	1.45	1.34	1.23	1.10	1.02	0.93	0.86	0.81	0.76	0.69	0.61	0.50
2013	1.10	6.33	7.97	6.47	5.66	5.48	5.13	4.60	4.02	3.50	3.11	2.87	2.55	2.33	2.11	1.83	1.74	1.60	1.47	1.38	1.23	1.16	1.07	1.02	0.94	0.89	0.86	0.78	0.72	0.62
2014	1.62	6.41	6.35	5.87	6.11	6.02	5.40	4.97	4.75	4.33	3.97	3.24	3.01	2.51	2.32	2.22	1.93	1.85	1.74	1.67	1.58	1.44	1.40	1.33	1.29	1.22	1.12	1.12	1.03	0.98
2015	1.52	5.24	6.45	7.24	7.18	6.63	6.16	5.56	5.17	4.95	4.04	3.55	3.00	2.50	2.33	2.00	1.92	1.89	1.66	1.50	1.53	1.48	1.40	1.33	1.28	1.10	1.14	1.11	1.04	0.91
2016	1.60	6.94	10.05	9.41	8.57	7.92	6.84	6.16	5.77	4.75	4.08	3.39	2.83	2.42	2.18	2.15	1.99	1.82	1.65	1.55	1.50	1.47	1.27	1.25	1.14	1.14	1.07	0.96	0.97	0.79
2017	1.72	9.24	10.05	9.48	8.75	8.01	7.60	6.74	5.77	5.02	4.04	3.36	2.92	2.52	2.26	2.11	1.91	1.80	1.74	1.60	1.45	1.40	1.41	1.27	1.20	1.13	1.11	1.01	0.98	0.78
2018	2.18	8.56	10.17	9.77	8.99	8.67	7.95	6.66	5.94	5.03	4.15	3.68	2.95	2.57	2.38	2.03	1.92	1.80	1.62	1.56	1.43	1.42	1.30	1.27	1.22	1.06	1.04	0.95	0.89	0.78
2019	2.32	9.06	10.49	9.56	9.14	8.77	7.64	6.70	5.82	4.76	4.40	3.50	2.89	2.54	2.21	2.14	1.91	1.78	1.60	1.52	1.44	1.31	1.35	1.28	1.16	1.13	1.04	0.95	0.86	0.78
2020	2.52	9.71	10.53	10.39	10.04	8.90	7.92	6.78	5.60	5.21	4.19	3.53	2.93	2.43	2.30	2.08	1.93	1.80	1.67	1.56	1.37	1.41	1.34	1.26	1.20	1.09	1.02	0.95	0.94	0.78
2021	2.62	10.12	11.92	11.78	10.33	9.54	8.04	6.60	6.37	5.17	4.40	3.74	2.89	2.57	2.34	2.10	1.96	1.75	1.67	1.49	1.60	1.42	1.36	1.24	1.10	1.11	1.02	0.92	0.86	0.73

Book/Policy	Cumulative Claim Rates All Mortgages by Credit Subsidy Endorsement Cohort																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.03	1.00	3.70	7.34	10.90	13.32	14.70	15.57	16.21	16.64	16.97	17.19	17.33	17.45	17.52	17.58	17.62	17.65	17.66	17.67	17.68	17.68	17.69	17.69	17.69	17.69	17.70	17.70	17.70	17.70
1985	0.02	0.85	3.66	7.35	10.06	11.78	12.99	13.89	14.54	14.98	15.28	15.46	15.62	15.73	15.80	15.85	15.88	15.91	15.92	15.93	15.94	15.94	15.94	15.95	15.95	15.95	15.96	15.96	15.96	15.96
1986	0.01	0.45	2.08	4.03	5.75	7.21	8.41	9.35	10.09	10.63	11.02	11.35	11.59	11.77	11.89	11.95	12.00	12.03	12.06	12.07	12.08	12.09	12.09	12.10	12.10	12.11	12.12	12.12	12.12	12.13
1987	0.01	0.37	1.38	2.57	3.74	4.84	5.77	6.59	7.21	7.70	8.13	8.47	8.72	8.88	8.97	9.03	9.08	9.12	9.14	9.15	9.16	9.17	9.18	9.19	9.20	9.21	9.22	9.22	9.22	
1988	0.01	0.41	1.51	2.95	4.51	5.83	6.94	7.79	8.42	8.93	9.34	9.64	9.84	9.95	10.03	10.09	10.13	10.16	10.18	10.18	10.20	10.21	10.22	10.23	10.24	10.25	10.25	10.26	10.26	10.27
1989	0.01	0.34	1.40	2.88	4.37	5.69	6.67	7.39	7.98	8.40	8.71	8.92	9.03	9.11	9.17	9.22	9.25	9.27	9.28	9.29	9.30	9.32	9.33	9.34	9.35	9.36	9.36	9.36	9.37	9.37
1990	0.01	0.30	1.35	2.85	4.27	5.31	6.06	6.71	7.19	7.53	7.75	7.88	7.96	8.03	8.07	8.10	8.12	8.13	8.15	8.16	8.18	8.19	8.20	8.21	8.22	8.23	8.23	8.23	8.23	8.23
1991	0.01	0.31	1.40	2.73	3.87	4.76	5.57	6.18	6.60	6.88	7.04	7.14	7.21	7.27	7.30	7.32	7.33	7.35	7.36	7.37	7.39	7.40	7.41	7.42	7.43	7.43	7.44	7.44	7.44	7.44
1992	0.00	0.21	0.91	1.83	2.79	3.82	4.71	5.35	5.77	6.01	6.16	6.26	6.32	6.35	6.38	6.40	6.41	6.43	6.44	6.46	6.47	6.49	6.50	6.52	6.53	6.54	6.55	6.55	6.56	6.57
1993	0.00	0.16	0.72	1.57	2.72	3.72	4.48	4.98	5.25	5.42	5.53	5.61	5.64	5.67	5.68	5.70	5.71	5.73	5.75	5.76	5.78	5.80	5.83	5.84	5.85	5.86	5.87	5.87	5.88	5.89
1994	0.00	0.22	0.93	2.09	3.35	4.35	4.98	5.33	5.57	5.73	5.83	5.89	5.92	5.95	5.97	5.99	6.02	6.04	6.06	6.09	6.11	6.14	6.16	6.17	6.19	6.20	6.21	6.23	6.24	6.25
1995	0.01	0.29	1.49	3.28	4.90	5.99	6.66	7.10	7.47	7.70	7.82	7.89	7.94	7.98	8.03	8.08	8.12	8.15	8.19	8.23	8.27	8.29	8.30	8.33	8.34	8.36	8.37	8.39	8.40	8.41
1996	0.00	0.31	1.59	3.33	4.67	5.52	6.11	6.59	6.88	7.04	7.14	7.20	7.25	7.30	7.36	7.42	7.47	7.51	7.57	7.61	7.64	7.66	7.68	7.70	7.72	7.74	7.75	7.76	7.78	7.79
1997	0.01	0.40	1.75	3.23	4.29	5.10	5.76	6.16	6.38	6.51	6.60	6.68	6.75	6.82	6.88	6.94	7.00	7.06	7.12	7.15	7.18	7.21	7.24	7.26	7.28	7.30	7.32	7.34	7.36	7.37
1998	0.01	0.34	1.35	2.37	3.25	4.05	4.55	4.85	5.03	5.15	5.25	5.34	5.44	5.53	5.61	5.70	5.78	5.86	5.90	5.93	5.97	5.99	6.02	6.03	6.05	6.06	6.07	6.08	6.09	6.10
1999	0.01	0.32	1.15	2.19	3.33	4.10	4.56	4.82	4.99	5.12	5.26	5.40	5.54	5.66	5.78	5.90	6.01	6.06	6.11	6.15	6.18	6.20	6.22	6.24	6.25	6.26	6.27	6.27	6.28	6.29
2000	0.01	0.50	1.88	3.65	4.85	5.51	5.89	6.13	6.34	6.51	6.69	6.83	6.95	7.07	7.20	7.31	7.37	7.42	7.47	7.51	7.54	7.57	7.59	7.61	7.62	7.63	7.65	7.66	7.67	7.68
2001	0.01	0.41	1.74	3.10	3.98	4.50	4.83	5.11	5.33	5.58	5.80	5.98	6.16	6.34	6.49	6.57	6.65	6.71	6.75	6.79	6.82	6.84	6.85	6.86	6.87	6.88	6.89	6.90	6.90	6.91
2002	0.01	0.46	1.67	2.75	3.46	3.96	4.37	4.73	5.12	5.45	5.74	6.04	6.33	6.58	6.72	6.84	6.95	7.02	7.08	7.13	7.17	7.20	7.23	7.25	7.27	7.28	7.30	7.31	7.32	7.33
2003	0.01	0.61	1.68	2.55	3.22	3.83	4.42	5.10	5.66	6.22	6.82	7.40	7.91	8.18	8.41	8.60	8.74	8.85	8.94	9.01	9.07	9.11	9.15	9.19	9.22	9.24	9.26	9.28	9.29	9.30
2004	0.12	0.93	1.97	2.95	3.98	4.98	6.10	7.05	8.00	9.00	10.06	10.97	11.45	11.87	12.21	12.45	12.65	12.81	12.93	13.04	13.13	13.20	13.26	13.31	13.36	13.40	13.43	13.46	13.48	13.50
2005	0.11	0.82	2.30	4.16	6.19	8.41	10.22	11.99	13.86	15.68	17.20	18.07	18.82	19.48	19.97	20.36	20.68	20.92	21.12	21.28	21.42	21.53	21.62	21.71	21.78	21.84	21.89	21.93	21.96	21.99
2006	0.02	0.63	2.64	5.62	9.14	11.84	14.43	17.23	19.65	21.59	22.69	23.63	24.45	25.04	25.50	25.85	26.11	26.31	26.48	26.61	26.71	26.79	26.86	26.91	26.96	26.99	27.02	27.04	27.05	27.07
2007	0.02	0.83	3.59	7.65	10.66	13.86	18.01	21.28	23.80	25.20	26.39	27.43	28.16	28.72	29.17	29.48	29.74	29.93	30.09	30.22	30.30	30.38	30.45	30.50	30.54	30.56	30.59	30.60	30.62	30.62
2008	0.01	0.69	3.28	5.90	8.85	12.83	15.94	18.26	19.49	20.54	21.42	22.07	22.56	22.95	23.22	23.44	23.61	23.74	23.84	23.92	23.99	24.05	24.09	24.13	24.15	24.18	24.20	24.21	24.22	24.23
2009	0.01	0.51	1.66	3.33	5.81	8.03	9.85	10.89	11.78	12.53	13.07	13.49	13.82	14.06	14.26	14.42	14.56	14.67	14.75	14.83	14.90	14.95	15.00	15.03	15.07	15.09	15.11	15.13	15.14	15.16
2010	0.01	0.23	0.91	2.16	3.62	5.02	5.90	6.70	7.42	7.97	8.41	8.77	9.03	9.25	9.43	9.59	9.72	9.82	9.92	10.00	10.07	10.13	10.18	10.23	10.27	10.30	10.33	10.36	10.38	10.40
2011	0.01	0.22	0.81	1.67	2.66	3.34	4.00	4.59	5.06	5.42	5.72	5.94	6.13	6.28	6.41	6.53	6.61	6.70	6.77	6.84	6.89	6.94	6.99	7.03	7.06	7.09	7.12	7.14	7.17	7.18
2012	0.01	0.15	0.60	1.34	1.98	2.61	3.20	3.68	4.05	4.38	4.61	4.79	4.95	5.07	5.18	5.28	5.35	5.43	5.49	5.54	5.59	5.64	5.68	5.71	5.74	5.78	5.80	5.83	5.85	5.87
2013	0.01	0.16	0.76	1.48	2.25	3.00	3.61	4.12	4.54	4.86	5.13	5.35	5.54	5.70	5.83	5.94	6.05	6.14	6.22	6.29	6.35	6.41	6.46	6.50	6.54	6.57	6.61	6.63	6.66	6.68
2014	0.01	0.25	0.99	2.05	3.20	4.17	5.03	5.80	6.37	6.91	7.35	7.69	8.01	8.22	8.41	8.59	8.75	8.88	8.99	9.10	9.19	9.28	9.36	9.42	9.48	9.53	9.58	9.61	9.64	9.66
2015	0.01	0.26	1.25	2.73	4.07	5.26	6.30	7.10	7.80	8.38	8.88	9.29	9.62	9.91	10.14	10.34	10.52	10.67	10.82	10.94	11.04	11.12	11.21	11.27	11.35	11.39	11.42	11.45	11.47	11.49
2016	0.01	0.42	1.85	3.49	4.96	6.25	7.26	8.08	8.77	9.36	9.87	10.27	10.63	10.93	11.21	11.43	11.65	11.84	12.01	12.15	12.27	12.37	12.46	12.53	12.59	12.64	12.68	12.71	12.73	12.75
2017	0.02	0.47	1.76	3.22	4.60	5.70	6.66	7.45	8.11	8.64	9.07	9.47	9.80	10.09	10.33	10.55	10.77	10.97	11.13	11.25	11.36	11.46	11.55	11.62	11.68	11.72	11.75	11.78	11.80	11.82
2018	0.01	0.41	1.60	3.04	4.17	5.16	5.98	6.73	7.35	7.82	8.25	8.62	8.97	9.24	9.47	9.70	9.90	10.07	10.21	10.33	10.44	10.53	10.62	10.68	10.74	10.77	10.80	10.83	10.84	10.86
2019	0.01	0.40	1.72	2.96	4.11	5.09	5.96	6.72	7.29	7.83	8.26	8.65	8.99	9.29	9.57	9.82	10.01	10.17	10.32	10.46	10.57	10.66	10.75	10.82	10.88	10.92	10.95	10.98	10.99	11.01
2020	0.01	0.45	1.59	2.90	4.13	5.19	6.13	6.84	7.47	8.00	8.45	8.83	9.17	9.48	9.78	10.01	10.22	10.39	10.56	10.71	10.83	10.95	11.04	11.11	11.17	11.22	11.26	11.29	11.32	11.33
2021	0.02	0.41	1.53	2.78	3.91	4.93	5.70	6.41	7.01	7.51	7.93	8.31	8.68	8.99	9.22	9.43	9.62	9.79	9.94	10.07	10.19	10.29	10.37	10.43	10.48	10.52	10.56	10.58	10.60	10.61

Cumulative Prepayment Rates		All Mortgages by Credit Subsidy Endorsement Cohort																												
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.278	1.771	22.23	43.74	50.35	54.59	58.43	61.84	66.25	69.9	72.87	73.82	74.77	75.52	76.49	77.56	77.87	78.13	78.41	78.7	78.95	79.1	79.31	79.38	79.48	79.65	79.7	79.78	79.83	80.71
1985	0.36	12.45	34.65	41.96	46.85	51.99	57.16	64.51	70.12	73.98	75.03	76.12	76.96	77.88	78.79	79.78	80.08	80.39	80.69	80.93	81.12	81.38	81.46	81.54	81.71	81.78	81.84	81.88	81.92	81.97
1986	0.59	4.63	7.47	10.68	14.93	19.77	31.25	48.38	59.87	62.33	65.70	68.17	71.70	74.90	76.49	78.78	80.37	81.85	82.79	83.38	84.07	84.32	84.50	84.73	84.86	85.03	85.14	85.26	85.35	85.39
1987	0.31	1.43	3.36	6.40	9.84	17.87	34.18	47.67	50.91	55.46	58.94	64.34	69.68	72.02	75.03	78.72	81.77	83.50	84.54	85.57	86.04	86.37	86.69	86.92	87.17	87.44	87.63	87.77	87.81	87.85
1988	0.41	2.08	5.52	10.39	24.00	44.65	58.17	61.05	64.94	67.72	71.53	75.11	76.79	78.56	80.66	82.74	83.90	84.64	85.43	85.76	86.02	86.22	86.36	86.54	86.69	86.86	86.96	87.01	87.05	87.08
1989	0.51	2.73	7.23	22.60	46.23	60.94	63.80	67.61	70.24	73.96	77.39	78.92	80.55	82.48	84.30	85.60	86.30	87.02	87.29	87.49	87.68	87.79	87.94	88.04	88.16	88.26	88.31	88.34	88.37	88.39
1990	0.40	2.54	13.04	41.61	59.49	62.60	66.87	69.74	73.92	77.79	79.42	81.23	83.44	85.44	86.79	87.68	88.51	88.80	88.99	89.17	89.31	89.44	89.54	89.65	89.74	89.78	89.81	89.83	89.86	89.87
1991	0.39	6.38	33.07	53.81	57.25	62.41	65.93	71.27	76.10	78.02	80.36	83.14	85.69	87.23	88.19	89.21	89.54	89.74	89.94	90.06	90.20	90.30	90.40	90.48	90.53	90.56	90.58	90.60	90.62	90.64
1992	0.62	9.90	25.49	30.33	38.23	44.22	54.15	63.45	67.02	71.80	77.37	82.75	85.58	87.16	88.30	89.20	89.59	89.85	90.07	90.25	90.44	90.61	90.73	90.79	90.84	90.87	90.90	90.92	90.94	90.96
1993	1.38	7.96	12.32	19.80	26.25	36.72	47.96	53.11	60.22	69.05	79.03	83.48	85.87	87.41	88.54	89.75	90.11	90.40	90.64	90.87	91.16	91.32	91.40	91.46	91.51	91.54	91.58	91.61	91.63	91.65
1994	0.90	3.81	10.77	17.44	28.31	39.39	45.02	52.94	62.31	74.06	79.68	82.81	84.79	86.08	87.41	88.44	88.82	89.15	89.47	89.83	90.08	90.19	90.27	90.33	90.38	90.43	90.47	90.50	90.53	90.56
1995	1.92	11.62	20.37	37.35	49.77	54.56	61.79	69.69	77.48	81.72	84.17	85.67	86.58	87.09	87.49	87.87	88.06	88.23	88.42	88.58	88.68	88.76	88.82	88.87	88.91	88.94	88.98	89.01	89.03	89.06
1996	0.62	4.88	22.74	38.56	44.41	53.73	64.09	74.97	80.45	83.54	85.34	86.42	87.06	87.48	87.88	88.29	88.51	88.75	88.95	89.07	89.16	89.22	89.28	89.33	89.38	89.42	89.45	89.48	89.51	89.53
1997	0.99	15.88	36.42	43.41	55.13	65.67	75.92	81.22	84.27	86.06	87.14	87.77	88.13	88.40	88.66	88.97	89.19	89.38	89.51	89.61	89.68	89.74	89.79	89.84	89.88	89.92	89.95	89.98	90.00	90.02
1998	2.05	12.56	19.24	32.31	48.33	68.17	77.21	82.03	84.63	86.14	87.03	87.65	88.10	88.48	88.87	89.43	89.72	89.92	90.05	90.15	90.23	90.30	90.37	90.43	90.48	90.52	90.56	90.60	90.63	90.66
1999	0.97	4.49	17.29	36.07	60.87	72.38	78.67	81.96	83.85	84.97	85.80	86.38	86.89	87.38	88.06	88.54	88.78	88.95	89.07	89.17	89.27	89.34	89.41	89.48	89.53	89.58	89.63	89.67	89.70	89.74
2000	0.97	29.98	54.66	71.24	78.85	83.13	85.43	86.78	87.48	87.89	88.16	88.36	88.56	88.81	89.04	89.20	89.31	89.39	89.45	89.51	89.57	89.61	89.65	89.69	89.72	89.75	89.78	89.80	89.82	89.84
2001	5.74	27.04	60.70	73.60	80.10	83.32	85.04	86.04	86.81	87.28	87.65	88.00	88.47	88.81	89.03	89.17	89.26	89.34	89.41	89.47	89.52	89.57	89.61	89.66	89.69	89.73	89.75	89.78	89.80	89.82
2002	4.75	41.28	60.00	70.48	75.80	78.91	80.67	82.08	82.98	83.68	84.38	85.34	85.97	86.36	86.62	86.78	86.91	87.03	87.12	87.21	87.28	87.35	87.41	87.47	87.52	87.56	87.60	87.64	87.67	87.70
2003	11.45	31.15	48.45	57.48	62.76	65.79	68.58	70.57	72.25	74.11	76.75	78.19	79.03	79.58	80.00	80.29	80.52	80.72	80.90	81.07	81.21	81.35	81.46	81.57	81.66	81.75	81.82	81.89	81.95	82.00
2004	7.82	27.38	39.58	47.01	50.98	54.37	56.88	59.05	61.77	65.87	68.00	69.32	70.14	70.79	71.32	71.70	72.02	72.31	72.57	72.80	73.01	73.19	73.36	73.50	73.64	73.76	73.86	73.96	74.05	74.13
2005	7.31	18.31	27.26	32.65	37.29	40.52	43.24	46.83	52.42	54.80	55.99	56.66	57.16	57.59	57.98	58.28	58.52	58.76	58.97	59.16	59.33	59.49	59.63	59.75	59.86	59.96	60.05	60.13	60.21	60.28
2006	1.44	9.10	17.35	27.23	32.32	36.04	40.73	47.43	50.11	51.30	51.87	52.27	52.60	52.89	53.14	53.34	53.52	53.68	53.84	53.98	54.10	54.21	54.31	54.41	54.49	54.56	54.63	54.70	54.76	54.82
2007	1.45	12.71	26.52	32.18	35.74	40.04	46.27	49.09	50.28	50.82	51.19	51.52	51.78	51.98	52.17	52.33	52.47	52.60	52.72	52.83	52.93	53.01	53.10	53.17	53.24	53.29	53.35	53.40	53.45	53.50
2008	2.14	24.27	33.72	38.85	45.22	53.40	56.58	57.88	58.50	58.92	59.29	59.60	59.83	60.04	60.23	60.39	60.53	60.65	60.77	60.87	60.96	61.04	61.12	61.19	61.25	61.31	61.36	61.41	61.45	61.50
2009	6.17	14.73	21.53	33.23	47.08	51.70	54.29	55.72	56.75	57.66	58.42	59.04	59.56	60.04	60.48	60.88	61.20	61.51	61.78	62.01	62.24	62.44	62.61	62.77	62.92	63.05	63.18	63.29	63.40	63.50
2010	1.88	7.13	17.08	31.32	38.19	42.97	45.84	47.93	49.70	51.24	52.49	53.49	54.37	55.16	55.89	56.49	57.02	57.48	57.89	58.27	58.61	58.91	59.19	59.44	59.66	59.87	60.07	60.25	60.42	60.58
2011	0.61	9.64	24.53	34.41	41.92	46.31	49.39	51.96	54.15	55.94	57.32	58.48	59.47	60.39	61.21	61.86	62.38	62.83	63.25	63.63	63.96	64.26	64.54	64.79	65.02	65.24	65.44	65.62	65.80	65.96
2012	1.08	11.00	20.97	29.52	34.99	39.08	42.55	45.53	48.04	50.02	51.67	53.11	54.44	55.63	56.72	57.53	58.15	58.71	59.22	59.69	60.11	60.49	60.84	61.15	61.44	61.71	61.97	62.20	62.42	62.63
2013	1.11	7.44	14.87	20.38	24.84	28.87	32.41	35.40	37.90	40.00	41.81	43.46	44.91	46.23	47.42	48.34	49.13	49.85	50.51	51.11	51.64	52.13	52.58	53.00	53.40	53.76	54.12	54.44	54.75	55.05
2014	1.63	7.99	13.86	18.90	23.77	28.20	31.90	35.08	37.95	40.44	42.62	44.32	45.87	47.13	48.29	49.30	50.12	50.89	51.60	52.27	52.89	53.45	53.98	54.49	54.98	55.44	55.86	56.28	56.69	57.14
2015	1.53	6.73	12.76	19.03	24.68	29.44	33.49	36.87	39.82	42.48	44.54	46.27	47.68	48.84	49.89	50.74	51.49	52.21	52.84	53.39	53.95	54.48	54.97	55.44	55.88	56.27	56.67	57.06	57.45	57.85
2016	1.61	8.48	17.68	25.29	31.42	36.47	40.43	43.69	46.52	48.71	50.49	51.90	53.04	54.00	54.85	55.62	56.29	56.88	57.40	57.89	58.34	58.79	59.17	59.54	59.87	60.20	60.51	60.80	61.11	61.39
2017	1.73	10.86	19.81	27.28	33.40	38.40	42.70	46.16	48.90	51.13	52.82	54.18	55.31	56.26	57.10	57.84	58.45	59.01	59.54	60.02	60.45	60.86	61.26	61.62	61.96	62.28	62.59	62.88	63.17	63.44
2018	2.19	10.61	19.70	27.42	33.71	39.13	43.60	47.01	49.82	52.04	53.77	55.24	56.38	57.35	58.23	58.92	59.52	60.08	60.57	61.03	61.45	61.85	62.22	62.58	62.92	63.22	63.51	63.78	64.05	64.32
2019	2.33	11.23	20.54	28.01	34.36	39.80	44.06	47.46	50.18	52.27	54.10	55.49	56.60	57.56	58.38	59.10	59.69	60.23	60.71	61.16	61.57	61.94	62.32	62.68	63.00	63.31	63.60	63.87	64.12	64.39
2020	2.53	12.05	21.30	29.35	36.20	41.55	45.82	49.12	51.64	53.83	55.50	56.84	57.91	58.78	59.58	60.25	60.82	61.35	61.83	62.27	62.65	63.03	63.39	63.72	64.03	64.32	64.59	64.85	65.11	65.36
2021	2.63	12.53	22.95	31.90	38.69	44.23	48.36	51.44	54.19	56.26	57.92	59.26	60.25	61.11	61.88	62.51	63.07	63.55	64.01	64.41	64.83	65.19	65.54	65.85	66.13	66.41	66.66	66.90	67.14	67.37

Conditional Claim Rates Fixed Rate 30 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.03	1.00	2.88	5.13	7.63	6.61	4.60	3.47	3.05	2.71	2.68	2.30	1.77	1.65	1.23	1.04	0.81	0.55	0.37	0.27	0.19	0.15	0.13	0.09	0.06	0.09	0.08	0.06	0.05	0.08
1985	0.02	0.88	3.43	6.35	5.73	4.29	3.62	3.29	3.29	3.20	3.05	2.16	2.08	1.76	1.21	1.24	0.73	0.54	0.38	0.32	0.21	0.15	0.11	0.16	0.15	0.10	0.12	0.08	0.03	0.06
1986	0.01	0.48	1.84	2.31	2.15	1.95	1.76	1.66	1.89	1.97	1.61	1.55	1.32	1.14	1.00	0.65	0.50	0.43	0.42	0.28	0.20	0.20	0.14	0.17	0.20	0.24	0.15	0.12	0.11	0.11
1987	0.01	0.36	1.06	1.28	1.30	1.32	1.27	1.45	1.48	1.27	1.28	1.14	1.02	0.87	0.51	0.43	0.44	0.41	0.30	0.20	0.18	0.15	0.25	0.23	0.28	0.19	0.19	0.14	0.17	0.03
1988	0.01	0.37	1.07	1.50	1.78	1.87	2.35	2.58	2.14	2.10	1.88	1.74	1.46	0.90	0.75	0.68	0.67	0.47	0.40	0.25	0.30	0.32	0.33	0.36	0.30	0.28	0.20	0.20	0.04	0.03
1989	0.01	0.31	1.06	1.62	1.98	2.72	3.02	2.50	2.41	2.01	1.79	1.58	0.98	0.85	0.76	0.74	0.58	0.49	0.36	0.32	0.37	0.47	0.46	0.45	0.34	0.24	0.27	0.06	0.08	0.03
1990	0.01	0.28	1.07	1.76	2.62	2.91	2.38	2.45	2.10	1.85	1.58	1.03	0.81	0.79	0.72	0.55	0.49	0.48	0.47	0.40	0.62	0.55	0.47	0.54	0.35	0.30	0.09	0.09	0.08	0.03
1991	0.01	0.31	1.21	2.15	2.78	2.42	2.56	2.21	1.91	1.72	1.08	0.93	0.82	0.80	0.67	0.49	0.43	0.49	0.47	0.48	0.64	0.47	0.57	0.46	0.37	0.16	0.10	0.11	0.09	0.03
1992	0.01	0.22	0.85	1.40	1.43	1.76	1.69	1.61	1.42	1.00	0.78	0.70	0.68	0.61	0.49	0.39	0.46	0.42	0.46	0.60	0.50	0.59	0.50	0.49	0.20	0.16	0.12	0.09	0.04	0.03
1993	0.00	0.15	0.59	0.94	1.31	1.38	1.34	1.17	0.75	0.63	0.59	0.67	0.57	0.47	0.36	0.37	0.39	0.54	0.56	0.52	0.73	0.65	0.77	0.16	0.16	0.17	0.09	0.10	0.07	0.02
1994	0.00	0.18	0.66	1.20	1.53	1.53	1.26	0.84	0.72	0.67	0.74	0.65	0.52	0.44	0.38	0.50	0.61	0.63	0.51	0.71	0.67	0.64	0.26	0.25	0.16	0.12	0.10	0.07	0.07	0.03
1995	0.00	0.26	1.17	1.98	2.38	2.25	1.67	1.32	1.57	1.55	1.28	1.04	0.89	0.89	0.96	1.22	1.11	0.90	1.08	0.99	1.11	0.45	0.36	0.39	0.22	0.20	0.14	0.09	0.08	0.03
1996	0.00	0.28	1.20	1.96	2.09	1.60	1.35	1.54	1.67	1.40	1.11	0.97	0.90	0.98	1.25	1.10	1.19	1.20	1.29	1.18	0.50	0.51	0.51	0.36	0.24	0.19	0.12	0.10	0.08	0.06
1997	0.01	0.37	1.41	2.02	1.69	1.67	1.95	2.14	1.89	1.51	1.28	1.27	1.22	1.47	1.33	1.19	1.42	1.56	1.43	0.69	0.59	0.57	0.45	0.35	0.20	0.16	0.10	0.07	0.07	0.03
1998	0.01	0.30	1.11	1.27	1.37	1.70	1.92	1.78	1.53	1.24	1.22	1.30	1.57	1.52	1.43	1.65	1.63	1.54	0.75	0.74	0.63	0.51	0.34	0.31	0.20	0.18	0.13	0.07	0.10	0.04
1999	0.01	0.35	0.98	1.43	2.09	2.45	2.26	1.79	1.47	1.44	1.49	1.85	1.90	1.74	1.89	2.00	1.81	0.99	0.89	0.76	0.56	0.41	0.35	0.23	0.18	0.13	0.11	0.09	0.06	0.04
2000	0.01	0.49	2.07	4.24	5.19	4.47	3.65	3.03	2.96	2.76	3.27	2.91	2.54	2.81	3.02	2.97	1.82	1.48	1.36	1.03	0.80	0.62	0.39	0.32	0.23	0.18	0.16	0.12	0.07	0.04
2001	0.01	0.50	1.99	3.92	4.10	3.44	2.91	2.79	2.60	3.17	3.07	2.82	3.01	3.27	2.95	1.77	1.61	1.37	1.11	0.72	0.64	0.45	0.33	0.30	0.21	0.16	0.14	0.09	0.07	0.04
2002	0.01	0.52	2.30	3.21	2.98	2.60	2.43	2.43	3.07	2.86	2.80	3.16	3.41	3.14	1.92	1.66	1.50	1.11	0.85	0.71	0.48	0.37	0.29	0.23	0.18	0.13	0.12	0.09	0.08	0.05
2003	0.01	0.77	1.82	2.09	1.93	1.97	2.14	2.83	2.58	2.80	3.39	3.77	3.53	2.07	1.86	1.65	1.19	0.94	0.82	0.56	0.47	0.33	0.29	0.23	0.15	0.12	0.10	0.07	0.07	0.03
2004	0.12	0.96	1.59	1.85	2.19	2.36	3.02	2.83	3.06	3.72	4.61	4.49	2.65	2.40	2.08	1.56	1.22	1.06	0.73	0.62	0.49	0.39	0.34	0.22	0.22	0.17	0.12	0.10	0.06	0.06
2005	0.11	0.74	1.76	2.52	3.10	3.87	3.60	3.84	4.72	5.68	5.37	3.30	2.91	2.63	1.99	1.52	1.25	0.94	0.73	0.55	0.46	0.38	0.27	0.25	0.18	0.14	0.10	0.07	0.06	0.03
2006	0.01	0.56	2.17	3.68	5.24	4.65	4.97	6.37	7.03	6.55	4.12	3.64	3.35	2.54	1.99	1.60	1.14	0.93	0.73	0.61	0.44	0.36	0.25	0.22	0.18	0.11	0.10	0.07	0.06	0.03
2007	0.02	0.79	3.12	5.74	4.92	5.90	8.97	9.17	8.48	5.29	4.87	4.54	3.42	2.71	2.27	1.61	1.34	1.04	0.84	0.68	0.47	0.42	0.35	0.28	0.18	0.14	0.12	0.07	0.05	0.03
2008	0.01	0.66	3.34	4.09	5.25	8.59	9.02	8.25	4.97	4.57	4.14	3.28	2.58	2.10	1.53	1.24	0.98	0.77	0.61	0.46	0.41	0.31	0.27	0.20	0.14	0.13	0.11	0.06	0.05	0.03
2009	0.01	0.44	1.08	1.79	3.30	3.95	3.64	2.28	2.21	2.04	1.60	1.29	1.06	0.75	0.65	0.53	0.43	0.35	0.27	0.24	0.21	0.18	0.13	0.11	0.10	0.08	0.05	0.04	0.03	0.02
2010	0.00	0.13	0.51	1.16	1.79	2.01	1.41	1.41	1.39	1.14	0.95	0.80	0.57	0.48	0.42	0.33	0.29	0.22	0.20	0.18	0.15	0.13	0.11	0.09	0.08	0.06	0.05	0.04	0.03	0.02
2011	0.00	0.11	0.41	0.94	1.30	1.03	1.12	1.09	0.95	0.76	0.65	0.47	0.37	0.31	0.29	0.22	0.18	0.17	0.15	0.13	0.10	0.09	0.08	0.07	0.05	0.05	0.04	0.03	0.02	0.02
2012	0.00	0.06	0.44	0.84	0.79	0.88	0.95	0.83	0.71	0.63	0.43	0.35	0.28	0.23	0.20	0.15	0.14	0.13	0.11	0.10	0.08	0.08	0.07	0.06	0.04	0.05	0.04	0.04	0.03	0.02
2013	0.00	0.11	0.54	0.75	0.89	1.00	0.89	0.82	0.71	0.52	0.46	0.38	0.30	0.27	0.20	0.19	0.17	0.15	0.12	0.12	0.11	0.09	0.07	0.07	0.06	0.05	0.05	0.03	0.03	0.02
2014	0.01	0.23	0.78	1.23	1.43	1.34	1.26	1.20	0.93	0.91	0.77	0.65	0.57	0.43	0.42	0.38	0.36	0.28	0.25	0.25	0.22	0.18	0.17	0.13	0.13	0.13	0.11	0.08	0.05	0.03
2015	0.01	0.25	1.07	1.71	1.69	1.67	1.59	1.33	1.24	1.10	1.00	0.87	0.68	0.64	0.55	0.49	0.43	0.40	0.36	0.33	0.27	0.23	0.23	0.16	0.18	0.12	0.10	0.07	0.05	0.03
2016	0.01	0.39	1.55	2.01	2.05	2.04	1.75	1.54	1.43	1.32	1.23	0.99	0.93	0.80	0.78	0.66	0.64	0.61	0.51	0.44	0.38	0.32	0.28	0.26	0.21	0.16	0.13	0.09	0.07	0.04
2017	0.01	0.45	1.47	1.84	1.96	1.77	1.67	1.54	1.41	1.23	1.06	1.02	0.89	0.85	0.70	0.64	0.64	0.62	0.48	0.41	0.37	0.34	0.31	0.26	0.22	0.15	0.11	0.11	0.07	0.05
2018	0.01	0.41	1.33	1.83	1.61	1.56	1.44	1.48	1.31	1.05	1.05																			

Conditional Prepayment Rates Fixed Rate 30 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.28	1.50	21.43	29.38	13.77	11.16	12.18	12.83	19.30	20.71	22.36	9.30	10.41	8.97	10.46	11.31	6.33	5.66	6.19	6.17	5.24	4.19	6.52	2.25	2.39	3.76	1.70	2.70	1.81	9.08
1985	0.36	12.26	25.79	12.06	9.86	12.21	14.56	24.77	26.28	25.94	9.73	11.51	9.89	12.36	13.09	7.34	6.85	7.91	7.85	6.55	4.99	9.30	2.80	3.04	6.18	2.24	2.45	1.67	1.66	2.00
1986	0.60	4.03	2.87	3.42	4.85	5.93	15.59	28.61	27.54	8.04	12.37	10.44	17.32	19.28	10.23	12.35	17.08	19.16	15.18	11.05	13.95	6.37	4.95	6.31	3.68	3.93	3.56	3.89	3.16	1.13
1987	0.27	0.94	1.81	3.02	3.61	9.24	21.16	22.48	6.88	10.76	9.25	16.25	19.50	10.27	13.42	19.32	24.45	18.79	14.05	15.83	7.85	6.46	6.79	5.24	5.36	5.04	5.21	4.00	1.19	0.96
1988	0.31	1.32	3.19	4.92	15.82	29.76	28.26	8.30	12.70	10.53	16.61	19.26	10.79	12.73	17.27	19.49	16.49	12.35	15.54	6.97	5.22	4.92	3.64	4.87	3.39	4.01	3.38	1.77	1.44	0.79
1989	0.32	1.85	4.37	16.81	32.16	30.23	8.50	12.94	10.55	17.16	19.70	10.99	13.26	18.49	20.64	17.96	13.55	16.49	7.20	5.20	4.79	3.52	4.76	3.54	3.99	3.35	2.01	1.57	1.12	0.73
1990	0.27	1.63	10.35	33.66	32.57	8.51	13.23	10.50	17.77	20.71	10.99	13.91	20.31	23.18	19.65	14.62	19.95	8.31	6.18	5.93	4.18	4.89	4.14	4.32	4.00	2.09	1.59	1.14	0.99	0.71
1991	0.29	5.14	29.49	33.27	7.88	13.35	10.53	18.92	21.71	10.80	14.86	21.79	26.28	21.85	16.05	19.31	8.96	6.40	6.48	4.24	4.76	3.98	4.28	3.90	2.21	1.66	1.33	0.95	0.85	0.69
1992	0.37	8.11	18.40	6.10	10.82	9.39	18.75	23.09	10.72	16.52	25.19	34.03	27.05	19.85	15.85	11.35	8.28	6.80	5.59	5.11	4.98	5.69	4.38	2.62	1.97	1.28	1.21	0.93	0.82	0.71
1993	0.63	4.14	3.74	7.06	7.24	13.31	17.96	10.17	15.65	25.14	40.46	30.74	23.14	16.92	12.39	9.29	7.92	6.66	6.09	6.13	6.88	5.53	3.32	2.66	1.89	1.44	1.40	1.32	1.00	0.86
1994	0.27	1.91	6.16	6.20	12.27	15.63	9.23	14.52	22.50	38.15	29.30	22.83	16.87	12.36	9.16	7.37	6.42	6.14	6.60	7.38	5.63	3.49	2.62	2.02	1.77	1.64	1.27	1.20	1.03	0.84
1995	2.01	9.46	7.32	17.94	20.17	9.58	16.27	24.68	34.96	28.85	23.37	18.12	13.13	8.68	6.03	5.34	4.98	4.95	5.54	4.86	3.56	3.01	2.21	1.90	1.59	1.34	1.26	1.15	0.96	0.80
1996	0.38	2.75	12.65	17.35	8.59	15.83	24.78	37.26	30.03	24.69	18.66	13.46	9.16	6.70	5.37	5.10	5.37	6.22	5.47	3.84	2.81	2.28	2.01	1.75	1.54	1.30	1.27	1.06	0.89	0.72
1997	0.71	11.17	18.61	7.96	16.23	25.36	36.83	29.82	24.32	18.26	12.90	9.04	6.34	4.98	4.63	4.81	5.76	5.31	4.21	3.14	2.36	1.92	1.86	1.56	1.34	1.38	1.10	1.00	0.80	0.77
1998	0.99	6.21	5.83	13.19	22.47	39.91	31.93	26.05	19.15	13.67	9.49	7.73	5.98	5.24	5.41	7.15	5.87	4.49	3.19	2.38	2.18	1.87	1.71	1.54	1.41	1.26	1.20	1.04	0.87	0.69
1999	0.52	2.79	12.10	22.12	38.92	31.49	26.31	19.08	13.68	9.50	7.99	6.18	5.46	5.68	7.81	6.01	4.34	3.25	2.39	2.13	1.97	1.67	1.58	1.46	1.29	1.13	1.11	0.94	0.87	0.71
2000	0.88	28.79	36.15	39.25	31.02	26.06	18.98	13.53	8.71	6.52	4.68	3.95	4.32	5.41	5.20	4.17	3.20	2.35	2.03	1.90	1.70	1.56	1.36	1.23	1.15	1.11	0.89	0.84	0.71	0.58
2001	5.40	19.79	45.21	33.60	26.83	19.21	13.17	9.36	8.65	5.93	4.91	5.28	7.52	5.69	3.84	2.66	2.08	1.88	1.70	1.46	1.38	1.28	1.20	1.15	1.03	0.99	0.79	0.66	0.64	0.51
2002	3.05	36.00	32.27	26.36	17.93	12.79	9.33	9.51	6.85	5.82	6.52	9.73	6.43	3.87	2.64	2.03	1.84	1.71	1.48	1.33	1.30	1.16	1.13	1.06	0.93	0.85	0.72	0.68	0.64	0.50
2003	6.35	19.33	23.89	16.40	11.77	8.13	8.57	7.01	6.55	8.10	13.34	7.50	4.13	2.66	2.12	1.87	1.77	1.60	1.48	1.43	1.38	1.27	1.17	1.14	0.98	0.88	0.83	0.68	0.59	0.52
2004	5.86	19.70	15.13	10.79	6.99	7.56	6.20	5.92	8.11	14.07	7.61	4.52	2.78	2.20	1.90	1.84	1.66	1.57	1.52	1.42	1.37	1.25	1.16	1.05	0.97	0.95	0.79	0.73	0.68	0.45
2005	6.24	9.75	9.03	6.42	7.41	5.90	5.66	8.25	14.62	6.86	3.29	1.88	1.22	1.10	1.05	0.98	0.85	0.90	0.82	0.81	0.79	0.73	0.67	0.57	0.53	0.48	0.43	0.42	0.37	0.26
2006	1.16	7.29	8.91	12.42	7.67	6.54	9.24	15.31	7.50	3.54	1.80	1.28	1.04	0.89	0.83	0.74	0.79	0.70	0.70	0.66	0.58	0.52	0.47	0.45	0.41	0.36	0.35	0.33	0.28	0.25
2007	1.26	10.93	15.78	8.02	5.92	8.04	13.65	7.88	3.88	1.90	1.37	1.27	1.03	0.80	0.80	0.71	0.74	0.66	0.66	0.62	0.54	0.47	0.49	0.42	0.37	0.33	0.33	0.28	0.25	0.24
2008	2.03	22.34	12.66	8.14	11.60	18.04	9.48	4.66	2.41	1.73	1.57	1.35	1.03	0.90	0.86	0.85	0.80	0.74	0.68	0.63	0.58	0.51	0.47	0.44	0.41	0.36	0.32	0.31	0.26	0.23
2009	6.95	9.23	8.05	15.01	22.53	10.49	6.84	4.15	3.14	2.78	2.38	1.87	1.54	1.44	1.35	1.33	1.25	1.18	1.06	0.94	0.92	0.83	0.72	0.69	0.60	0.59	0.53	0.49	0.44	0.36
2010	1.70	4.94	10.47	17.32	10.38	8.38	5.62	4.29	3.67	3.29	2.70	2.08	1.84	1.68	1.61	1.53	1.48	1.31	1.18	1.14	1.02	0.93	0.86	0.77	0.70	0.67	0.63	0.57	0.49	0.42
2011	0.54	8.82	16.16	13.36	12.34	8.45	6.30	5.34	4.66	3.87	2.89	2.36	1.97	1.83	1.73	1.65	1.50	1.35	1.29	1.17	1.05	0.98	0.90	0.84	0.76	0.73	0.67	0.58	0.54	0.43
2012	1.03	8.99	11.24	11.75	8.91	7.25	6.32	5.67	4.84	3.75	2.92	2.43	2.15	1.93	1.82	1.72	1.57	1.46	1.38	1.27	1.17	1.06	0.99	0.88	0.83	0.79	0.72	0.67	0.59	0.49
2013	0.79	5.92	8.21	7.28	6.35	5.97	5.64	4.96	4.34	3.63	3.01	2.65	2.31	2.09	1.98	1.76	1.71	1.58	1.44	1.37	1.25	1.19	1.10	1.07	0.98	0.93	0.88	0.81	0.76	0.67
2014	1.38	5.71	6.02	5.66	5.79	5.73	5.18	4.80	4.61	4.23	3.87	3.12	2.91	2.42	2.28	2.23	1.95	1.88	1.76	1.71	1.63	1.49	1.44	1.40	1.37	1.29	1.18	1.18	1.09	1.05
2015	1.18	4.71	6.11	6.86	6.83	6.40	5.95	5.37	4.92	4.76	3.89	3.42	2.89	2.41	2.30	1.99	1.94	1.90	1.67	1.51	1.54	1.50	1.42	1.35	1.30	1.12	1.16	1.13	1.06	0.94
2016	1.34	6.46	9.71	9.05	8.31	7.76	6.67	6.01	5.56	4.56	3.96	3.27	2.73	2.34	2.14	2.14	2.00	1.81	1.64	1.54	1.47	1.46	1.27	1.26	1.15	1.14	1.07	0.97	0.98	0.80
2017	1.34	8.31	9.31	8.99	8.31	7.72	7.37	6.55	5.54	4.84	3.85	3.22	2.80	2.43	2.22	2.09	1.88	1.77	1.72	1.57	1.43	1.38	1.40	1.28	1.21	1.14	1.12	1.02	0.99	0.79
2018	1.35	6.61	8.91	8.91	8.32	8.25	7.57	6.33	5.65	4.77	3.87	3.49	2.77	2.42	2.27	1.97	1.87	1.77	1.61	1.53	1.41	1.42	1.29	1.27	1.22	1.07	1.05	0.96	0.91	0.80
2019	1.32	7.07	9.25	8.74	8.48	8.28	7.26	6.47	5.57	4.52	4.21	3.29	2.68	2.41	2.10	2.08	1.87	1.77	1.58	1.49	1.42	1.29	1.34	1.28	1.17	1.14	1.05	0.97	0.87	0.80
2020	1.34	7.18	8.98	9.45	9.28	8.40	7.58	6.50	5.33	4.94	3.97	3.32	2.75	2.34	2.24	2.05	1.93	1.79	1.65	1.54	1.35	1.40	1.34	1.27	1.21	1.09	1.03	0.95	0.94	0.79
2021	1.13	7.26	10.15	10.56	9.49	8.98	7.61	6.27	6.05	4.89	4.15	3.52	2.69	2.45	2.26	2.05	1.90	1.71	1.63	1.46	1.58	1.40	1.34	1.25	1.10	1.12	1.03	0.93	0.87	0.74

Cumulative Claim Rates Fixed Rate 30 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.03	1.03	3.84	7.62	11.29	13.79	15.23	16.13	16.79	17.24	17.58	17.81	17.95	18.08	18.16	18.22	18.26	18.29	18.30	18.32	18.32	18.33	18.33	18.34	18.34	18.34	18.34	18.34	18.35	18.35
1985	0.02	0.90	3.87	7.76	10.63	12.44	13.71	14.66	15.34	15.80	16.12	16.31	16.47	16.59	16.66	16.73	16.76	16.78	16.80	16.81	16.82	16.82	16.82	16.83	16.83	16.83	16.84	16.84	16.84	16.84
1986	0.01	0.49	2.24	4.33	6.17	7.72	9.01	10.01	10.81	11.39	11.82	12.18	12.44	12.63	12.76	12.84	12.89	12.92	12.95	12.96	12.97	12.98	12.99	12.99	13.00	13.01	13.01	13.02	13.02	13.03
1987	0.01	0.38	1.42	2.65	3.84	4.99	5.98	6.85	7.53	8.07	8.54	8.91	9.19	9.38	9.48	9.55	9.61	9.65	9.67	9.69	9.70	9.70	9.72	9.73	9.74	9.75	9.75	9.76	9.77	9.77
1988	0.01	0.38	1.43	2.84	4.40	5.76	6.92	7.81	8.46	9.01	9.43	9.75	9.96	10.08	10.16	10.22	10.27	10.30	10.32	10.33	10.34	10.35	10.36	10.37	10.38	10.39	10.40	10.40	10.41	10.41
1989	0.01	0.32	1.35	2.85	4.34	5.69	6.69	7.42	8.02	8.45	8.76	8.98	9.09	9.18	9.24	9.29	9.32	9.34	9.35	9.36	9.38	9.39	9.40	9.42	9.43	9.43	9.44	9.44	9.44	9.44
1990	0.01	0.29	1.34	2.87	4.33	5.39	6.15	6.81	7.30	7.65	7.88	8.01	8.10	8.17	8.21	8.24	8.26	8.28	8.30	8.31	8.32	8.34	8.35	8.36	8.37	8.38	8.38	8.38	8.38	8.38
1991	0.01	0.32	1.46	2.87	4.04	4.95	5.76	6.37	6.79	7.07	7.23	7.34	7.41	7.47	7.50	7.53	7.54	7.56	7.57	7.58	7.60	7.61	7.62	7.64	7.64	7.65	7.65	7.65	7.65	7.65
1992	0.01	0.23	1.01	2.04	3.02	4.07	4.97	5.65	6.10	6.38	6.56	6.68	6.75	6.80	6.83	6.85	6.87	6.89	6.91	6.93	6.95	6.97	6.98	7.00	7.01	7.01	7.01	7.02	7.02	7.02
1993	0.00	0.16	0.72	1.58	2.68	3.74	4.62	5.23	5.58	5.83	6.00	6.11	6.18	6.22	6.25	6.27	6.29	6.32	6.35	6.37	6.40	6.43	6.45	6.46	6.47	6.47	6.48	6.48	6.48	6.48
1994	0.00	0.18	0.83	1.93	3.21	4.32	5.08	5.53	5.86	6.09	6.25	6.35	6.40	6.45	6.48	6.51	6.55	6.59	6.62	6.66	6.70	6.72	6.74	6.75	6.75	6.76	6.76	6.77	6.77	6.77
1995	0.00	0.26	1.30	2.91	4.45	5.58	6.32	6.80	7.22	7.48	7.63	7.72	7.78	7.84	7.89	7.95	8.01	8.05	8.09	8.13	8.17	8.19	8.20	8.22	8.22	8.23	8.24	8.24	8.24	8.24
1996	0.00	0.28	1.45	3.09	4.49	5.45	6.12	6.68	7.06	7.27	7.39	7.48	7.55	7.62	7.70	7.76	7.83	7.89	7.95	8.00	8.03	8.05	8.07	8.08	8.09	8.10	8.10	8.11	8.11	8.11
1997	0.01	0.38	1.62	3.04	4.11	4.98	5.71	6.21	6.50	6.68	6.79	6.89	6.98	7.08	7.16	7.23	7.31	7.38	7.45	7.48	7.51	7.53	7.55	7.56	7.57	7.57	7.58	7.58	7.58	7.59
1998	0.01	0.31	1.34	2.43	3.45	4.40	5.02	5.41	5.64	5.80	5.92	6.04	6.18	6.30	6.40	6.51	6.61	6.70	6.74	6.78	6.81	6.84	6.85	6.87	6.88	6.89	6.89	6.90	6.90	6.90
1999	0.01	0.36	1.31	2.51	3.85	4.77	5.33	5.64	5.85	6.02	6.18	6.35	6.52	6.66	6.81	6.94	7.05	7.11	7.16	7.20	7.23	7.25	7.27	7.28	7.29	7.30	7.30	7.31	7.31	7.31
2000	0.01	0.50	1.95	3.79	5.06	5.75	6.14	6.40	6.60	6.77	6.95	7.10	7.22	7.34	7.47	7.58	7.64	7.69	7.73	7.76	7.79	7.80	7.81	7.82	7.83	7.83	7.84	7.84	7.84	7.85
2001	0.01	0.48	1.99	3.55	4.56	5.15	5.54	5.85	6.10	6.37	6.61	6.81	7.01	7.21	7.37	7.45	7.53	7.59	7.64	7.67	7.70	7.72	7.73	7.74	7.75	7.76	7.77	7.77	7.77	7.77
2002	0.01	0.52	1.93	3.23	4.07	4.65	5.11	5.51	5.96	6.34	6.68	7.02	7.35	7.62	7.77	7.89	8.00	8.08	8.14	8.18	8.22	8.24	8.26	8.27	8.28	8.29	8.30	8.31	8.31	8.31
2003	0.01	0.74	2.11	3.27	4.15	4.92	5.67	6.56	7.29	8.01	8.78	9.50	10.09	10.41	10.68	10.92	11.08	11.21	11.31	11.38	11.44	11.48	11.52	11.54	11.56	11.58	11.59	11.60	11.60	11.61
2004	0.12	1.03	2.21	3.36	4.55	5.71	7.05	8.19	9.32	10.54	11.77	12.82	13.38	13.87	14.27	14.55	14.77	14.95	15.07	15.17	15.25	15.31	15.37	15.40	15.43	15.46	15.48	15.49	15.50	15.51
2005	0.11	0.80	2.28	4.17	6.29	8.65	10.64	12.56	14.63	16.64	18.29	19.22	20.00	20.67	21.16	21.52	21.81	22.02	22.19	22.31	22.41	22.49	22.54	22.60	22.64	22.67	22.69	22.71	22.72	22.73
2006	0.01	0.57	2.56	5.55	9.12	11.88	14.49	17.37	19.85	21.81	22.93	23.86	24.67	25.25	25.70	26.05	26.29	26.48	26.63	26.75	26.84	26.91	26.96	27.01	27.04	27.06	27.08	27.10	27.11	27.12
2007	0.02	0.81	3.54	7.61	10.62	13.83	18.03	21.35	23.89	25.28	26.46	27.50	28.23	28.79	29.24	29.55	29.80	29.99	30.14	30.26	30.34	30.42	30.48	30.53	30.56	30.58	30.60	30.62	30.63	30.63
2008	0.01	0.66	3.19	5.79	8.72	12.70	15.76	18.03	19.23	20.25	21.11	21.75	22.23	22.61	22.88	23.09	23.26	23.38	23.48	23.56	23.62	23.67	23.71	23.74	23.77	23.79	23.80	23.81	23.82	23.82
2009	0.01	0.43	1.34	2.71	4.82	6.68	8.14	8.96	9.71	10.36	10.84	11.22	11.51	11.72	11.89	12.03	12.14	12.23	12.30	12.36	12.41	12.45	12.48	12.51	12.53	12.55	12.56	12.57	12.58	12.59
2010	0.00	0.13	0.61	1.58	2.80	3.99	4.74	5.45	6.10	6.60	7.00	7.33	7.56	7.74	7.90	8.02	8.13	8.21	8.28	8.34	8.39	8.44	8.47	8.51	8.53	8.55	8.57	8.58	8.59	8.60
2011	0.00	0.11	0.48	1.20	2.05	2.62	3.19	3.70	4.12	4.43	4.69	4.87	5.00	5.12	5.22	5.29	5.36	5.41	5.46	5.51	5.54	5.57	5.59	5.62	5.63	5.65	5.66	5.67	5.68	5.69
2012	0.00	0.07	0.47	1.13	1.68	2.24	2.78	3.23	3.58	3.88	4.08	4.23	4.35	4.44	4.52	4.58	4.64	4.69	4.73	4.77	4.80	4.83	4.86	4.88	4.90	4.91	4.93	4.94	4.95	4.96
2013	0.00	0.11	0.62	1.26	1.97	2.69	3.29	3.81	4.23	4.53	4.78	4.97	5.12	5.26	5.35	5.44	5.52	5.58	5.64	5.69	5.74	5.77	5.80	5.83	5.86	5.88	5.90	5.91	5.93	5.93
2014	0.01	0.24	0.96	2.04	3.19	4.19	5.06	5.84	6.41	6.94	7.36	7.70	7.98	8.19	8.38	8.56	8.72	8.84	8.95	9.05	9.14	9.21	9.28	9.33	9.38	9.43	9.47	9.50	9.53	9.54
2015	0.01	0.25	1.27	2.77	4.12	5.33	6.40	7.22	7.93	8.53	9.04	9.45	9.76	10.05	10.28	10.49	10.66	10.81	10.95	11.07	11.17	11.25	11.33	11.39	11.45	11.48	11.52	11.54	11.56	11.57
2016	0.01	0.40	1.83	3.47	4.95	6.28	7.30	8.12	8.83	9.43	9.97	10.37	10.73	11.02	11.30	11.53	11.75	11.95	12.11	12.25	12.36	12.46	12.54	12.61	12.67	12.71	12.75	12.77	12.79	12.81
2017	0.01	0.46	1.79	3.27	4.67	5.81	6.78	7.59	8.27	8.82	9.27	9.67	10.01	10.32	10.56	10.78	10.99	11.18	11.33	11.45	11.56	11.66	11.74	11.82	11.87	11.91	11.94	11.97	11.99	12.01
2018	0.01	0.43	1.65	3.16	4.35	5.38	6.23	7.03	7.68	8.16	8.61	9.00	9.36	9.64	9.87	10.11	10.32	10.49	10.63	10.75	10.86	10.95	11.03	11.10	11.15	11.18	11.21	11.23	11.24	11.25
2019	0.01	0.40	1.76	3.06	4.26	5.30	6.20	7.01	7.60	8.17	8.64	9.04	9.40	9.71	10.01	10.26	10.47	10.64	10.80	10.94	11.06	11.15	11.23	11.30	11.36	11.40	11.43	11.45	11.46	11.47
2020	0.01	0.48	1.68	3.06	4.34	5.46	6.43	7.19	7.86	8.41	8.88	9.27	9.61	9.94	10.27	10.51	10.73	10.92	11.10	11.25	11.38	11.49	11.59	11.66	11.71	11.76	11.81	11.84	11.87	11.88
2021	0.02	0.42	1.60	2.92	4.15	5.26	6.08	6.85	7.50	8.04	8.52	8.94	9.35	9.69	9.94	10.16	10.38	10.56	10.73	10.87	10.99	11.10	11.18	11.25	11.30	11.35	11.39	11.41	11.43	11.44

Cumulative Prepayment Rates Fixed Rate 30 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	0.28	1.78	22.64	44.25	50.88	55.10	58.89	62.22	66.41	69.92	72.80	73.70	74.59	75.27	75.97	76.64	76.97	77.25	77.55	77.86	78.12	78.28	78.50	78.58	78.69	78.86	78.92	79.00	79.06	79.98
1985	0.36	12.60	34.94	42.33	47.26	52.40	57.53	64.68	70.13	73.91	74.92	75.96	76.73	77.57	78.34	78.71	79.03	79.37	79.69	79.95	80.15	80.44	80.52	80.60	80.78	80.87	80.93	80.97	81.01	81.07
1986	0.60	4.61	7.34	10.44	14.58	19.29	30.70	48.02	59.60	61.99	65.30	67.70	71.21	74.38	75.72	77.16	78.89	80.49	81.51	82.15	82.89	83.16	83.36	83.61	83.75	83.92	84.04	84.17	84.27	84.31
1987	0.27	1.21	2.99	5.89	9.20	17.24	33.74	47.30	50.47	55.01	58.45	63.85	69.19	71.43	74.03	77.25	80.52	82.40	83.53	84.64	85.15	85.49	85.83	86.08	86.35	86.62	86.83	86.98	87.02	87.06
1988	0.31	1.63	4.76	9.39	23.30	44.86	58.83	61.68	65.57	68.31	72.10	75.67	77.26	78.90	80.82	82.59	83.79	84.53	85.34	85.66	85.91	86.10	86.24	86.42	86.57	86.74	86.85	86.90	86.95	86.98
1989	0.32	2.17	6.45	21.98	46.20	61.17	63.99	67.80	70.42	74.14	77.58	79.09	80.69	82.59	84.31	85.47	86.19	86.93	87.20	87.40	87.58	87.70	87.85	87.95	88.08	88.18	88.23	88.27	88.30	88.32
1990	0.27	1.90	12.05	41.26	59.47	62.56	66.81	69.66	73.86	77.77	79.38	81.17	83.38	85.37	86.65	87.41	88.28	88.57	88.77	88.95	89.09	89.23	89.33	89.44	89.53	89.58	89.61	89.64	89.66	89.68
1991	0.29	5.44	33.31	55.03	58.36	63.39	66.74	71.96	76.68	78.48	80.64	83.30	85.78	87.28	88.12	88.97	89.29	89.50	89.69	89.82	89.96	90.06	90.17	90.26	90.30	90.34	90.37	90.39	90.41	90.43
1992	0.37	8.49	25.31	29.83	37.23	42.86	52.86	62.63	66.05	70.68	76.49	82.30	85.30	86.88	87.89	88.49	88.88	89.18	89.40	89.61	89.81	90.00	90.13	90.21	90.27	90.31	90.34	90.37	90.39	90.41
1993	0.64	4.76	8.33	14.79	20.87	31.10	42.85	48.22	55.57	65.39	77.12	82.34	85.03	86.53	87.44	88.03	88.49	88.85	89.15	89.44	89.76	89.97	90.10	90.19	90.26	90.31	90.36	90.40	90.44	90.47
1994	0.27	2.19	8.21	13.88	24.24	35.59	41.17	49.02	59.29	72.68	78.93	82.33	84.26	85.42	86.17	86.73	87.17	87.57	87.97	88.39	88.68	88.85	88.97	89.06	89.13	89.20	89.26	89.31	89.36	89.41
1995	2.01	11.30	17.80	32.35	45.44	50.26	57.48	66.45	75.86	80.76	83.52	85.13	86.08	86.62	86.95	87.23	87.48	87.71	87.95	88.15	88.28	88.39	88.47	88.54	88.59	88.63	88.68	88.72	88.75	88.78
1996	0.38	3.13	15.39	29.84	35.63	45.15	57.44	71.10	77.80	81.56	83.66	84.87	85.58	86.04	86.39	86.70	87.00	87.33	87.60	87.77	87.89	87.99	88.07	88.14	88.20	88.25	88.30	88.35	88.38	88.42
1997	0.71	11.85	28.23	33.84	44.13	57.30	71.26	78.15	81.97	84.09	85.29	86.01	86.46	86.80	87.08	87.37	87.68	87.95	88.15	88.30	88.40	88.48	88.55	88.62	88.67	88.72	88.77	88.81	88.84	88.88
1998	0.99	7.17	12.59	24.01	40.60	63.04	73.48	79.11	82.09	83.78	84.77	85.50	86.01	86.43	86.83	87.32	87.69	87.95	88.12	88.25	88.36	88.45	88.54	88.61	88.68	88.74	88.79	88.84	88.89	88.93
1999	0.52	3.31	15.01	33.57	58.56	70.44	77.00	80.38	82.31	83.44	84.29	84.89	85.37	85.84	86.44	86.85	87.12	87.32	87.45	87.57	87.68	87.76	87.84	87.92	87.98	88.04	88.10	88.14	88.19	88.24
2000	0.88	29.50	54.86	71.86	79.44	83.49	85.54	86.67	87.28	87.68	87.94	88.15	88.36	88.60	88.82	88.97	89.09	89.16	89.23	89.29	89.34	89.39	89.43	89.46	89.49	89.53	89.55	89.57	89.60	89.62
2001	5.42	24.22	58.39	71.74	78.40	81.69	83.43	84.47	85.31	85.83	86.21	86.60	87.10	87.44	87.65	87.78	87.88	87.97	88.05	88.11	88.17	88.23	88.28	88.32	88.36	88.41	88.44	88.46	88.49	88.52
2002	3.06	38.12	57.99	68.60	73.67	76.53	78.30	79.89	80.90	81.67	82.46	83.53	84.14	84.48	84.69	84.84	84.98	85.10	85.21	85.30	85.38	85.46	85.53	85.60	85.66	85.71	85.76	85.80	85.85	85.89
2003	6.39	24.58	42.50	51.63	56.97	60.15	63.16	65.37	67.22	69.31	72.36	73.79	74.49	74.91	75.22	75.49	75.74	75.95	76.15	76.34	76.51	76.67	76.81	76.95	77.06	77.17	77.27	77.35	77.43	77.51
2004	5.91	24.52	35.84	42.55	46.36	50.09	52.85	55.24	58.24	62.84	64.89	65.95	66.55	67.00	67.37	67.72	68.02	68.30	68.56	68.80	69.03	69.23	69.42	69.58	69.73	69.88	70.01	70.13	70.25	70.34
2005	6.34	15.51	23.11	27.92	32.99	36.60	39.72	43.85	50.27	52.69	53.71	54.24	54.57	54.86	55.12	55.36	55.56	55.77	55.96	56.14	56.32	56.48	56.62	56.74	56.86	56.96	57.06	57.15	57.24	57.32
2006	1.17	8.40	16.54	26.63	31.85	35.73	40.61	47.54	50.19	51.25	51.74	52.07	52.32	52.53	52.72	52.88	53.05	53.20	53.34	53.48	53.60	53.70	53.80	53.89	53.97	54.05	54.12	54.19	54.25	54.31
2007	1.27	12.09	25.89	31.57	35.19	39.59	46.00	48.85	50.01	50.51	50.85	51.14	51.36	51.53	51.69	51.83	51.97	52.09	52.21	52.32	52.42	52.50	52.59	52.66	52.73	52.79	52.85	52.90	52.95	53.00
2008	2.04	24.01	33.57	38.74	45.22	53.59	56.80	58.09	58.67	59.05	59.38	59.65	59.84	60.00	60.16	60.30	60.44	60.56	60.67	60.78	60.87	60.95	61.03	61.10	61.16	61.22	61.27	61.32	61.37	61.41
2009	6.98	15.62	22.40	33.95	48.31	53.26	56.02	57.52	58.58	59.48	60.20	60.75	61.19	61.59	61.96	62.31	62.64	62.95	63.22	63.46	63.69	63.89	64.07	64.24	64.39	64.53	64.66	64.78	64.90	65.01
2010	1.71	6.60	16.43	30.89	37.95	42.95	45.96	48.09	49.81	51.27	52.42	53.28	54.01	54.67	55.29	55.86	56.41	56.88	57.30	57.71	58.07	58.39	58.69	58.95	59.19	59.42	59.64	59.84	60.02	60.20
2011	0.55	9.36	24.07	34.22	42.24	46.99	50.19	52.70	54.75	56.36	57.50	58.40	59.14	59.81	60.42	61.00	61.52	61.98	62.41	62.80	63.15	63.46	63.75	64.02	64.27	64.50	64.72	64.92	65.11	65.28
2012	1.04	10.01	20.21	29.60	35.82	40.40	44.06	47.10	49.53	51.31	52.63	53.70	54.62	55.43	56.17	56.86	57.48	58.05	58.58	59.06	59.49	59.89	60.25	60.57	60.87	61.16	61.43	61.68	61.91	62.12
2013	0.79	6.73	14.43	20.67	25.68	30.04	33.87	37.02	39.61	41.67	43.30	44.69	45.87	46.91	47.87	48.71	49.51	50.24	50.89	51.50	52.05	52.57	53.05	53.50	53.92	54.32	54.69	55.04	55.38	55.72
2014	1.40	7.08	12.70	17.62	22.30	26.61	30.22	33.36	36.19	38.65	40.78	42.42	43.89	45.08	46.16	47.20	48.08	48.91	49.68	50.41	51.09	51.70	52.29	52.86	53.41	53.92	54.40	54.88	55.34	55.86
2015	1.19	5.88	11.65	17.65	23.12	27.80	31.80	35.15	38.01	40.60	42.61	44.28	45.64	46.73	47.74	48.60	49.40	50.18	50.85	51.44	52.04	52.61	53.14	53.65	54.13	54.55	54.98	55.41	55.83	56.27
2016	1.35	7.76	16.71	24.1																										

Conditional Claim Rates Fixed Rate 30 Year Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1993	0.01	0.20	0.71	1.08	1.55	1.42	1.16	0.88	0.47	0.35	0.29	0.29	0.21	0.11	0.12	0.15	0.17	0.26	0.29	0.22	0.37	0.51	0.74	0.45	0.53	0.45	0.33	0.35	0.16	0.22
1994	0.01	0.32	0.79	1.15	1.27	1.06	0.80	0.51	0.37	0.31	0.29	0.27	0.18	0.16	0.14	0.16	0.40	0.25	0.31	0.37	0.64	0.77	0.49	0.49	0.41	0.36	0.25	0.26	0.19	0.16
1995	0.02	0.42	1.40	2.00	1.83	1.80	1.20	0.83	0.86	0.93	0.66	0.76	0.71	0.08	0.28	0.82	1.12	0.79	0.82	1.28	1.35	0.84	0.69	0.61	0.73	0.13	0.87	0.71	0.85	0.34
1996	0.02	0.50	1.47	1.84	1.63	0.91	0.68	0.72	0.73	0.58	0.73	0.41	0.45	0.40	0.89	0.44	0.62	1.04	1.32	1.74	0.99	1.05	0.91	0.69	0.53	0.36	0.39	0.33	0.16	0.30
1997	0.02	0.63	1.74	2.15	1.46	1.06	1.06	0.99	0.86	0.74	0.66	0.81	0.83	0.88	1.15	0.73	0.54	1.38	1.50	1.34	0.78	1.34	1.34	0.19	0.37	0.24	0.51	0.11	0.15	0.32
1998	0.00	0.22	0.79	0.80	0.71	0.79	1.12	0.92	0.72	0.61	0.59	0.79	1.06	0.99	0.72	1.12	1.90	2.47	1.30	1.23	1.30	0.66	0.67	0.43	0.48	0.40	0.49	0.32	0.31	0.15
1999	0.01	0.25	0.50	0.64	0.80	0.94	0.94	0.75	0.55	0.69	0.73	0.84	0.88	1.03	1.27	1.79	2.08	1.36	1.04	0.95	0.78	0.75	0.49	0.54	0.50	0.29	0.32	0.18	0.23	0.25
2000	0.02	0.36	1.18	1.94	3.19	2.79	1.72	1.63	1.94	1.10	1.38	2.28	1.70	2.45	2.05	3.24	3.10	1.84	2.47	1.29	0.90	0.26	0.07	0.28	0.74	0.94	1.16	0.10	0.20	0.12
2001	0.00	0.20	1.27	2.70	2.91	2.85	2.32	2.44	2.48	3.41	3.30	2.71	3.05	4.70	5.25	3.07	2.96	2.33	1.44	1.52	1.33	0.89	0.74	0.79	0.68	0.84	0.60	0.36	0.43	0.36
2002	0.01	0.41	1.80	2.23	2.02	1.75	1.77	1.90	2.40	2.46	2.28	2.79	3.71	4.57	2.62	2.27	1.91	1.53	1.16	1.00	0.76	0.80	0.70	0.70	0.50	0.37	0.48	0.37	0.37	0.19
2003	0.01	0.56	1.26	1.26	1.21	1.33	1.52	2.11	1.98	2.29	2.62	3.83	4.01	2.44	2.06	1.65	1.31	1.13	0.97	0.81	0.78	0.64	0.67	0.57	0.48	0.43	0.38	0.33	0.29	0.18
2004	0.14	0.84	1.13	1.17	1.38	1.58	2.19	2.14	2.35	2.76	4.11	3.95	2.39	1.96	1.57	1.16	1.05	0.91	0.77	0.71	0.59	0.59	0.54	0.45	0.40	0.36	0.34	0.29	0.22	0.16
2005	0.11	0.66	1.57	2.03	2.48	3.22	3.13	3.42	3.85	4.20	4.05	2.62	2.36	2.05	1.39	1.31	1.06	0.72	0.69	0.68	0.51	0.50	0.36	0.35	0.27	0.30	0.22	0.14	0.17	0.13
2006	0.06	1.04	2.30	3.31	4.54	4.07	4.72	5.56	5.47	5.56	3.71	3.29	2.89	1.95	1.91	1.49	1.10	0.67	0.70	0.75	0.54	0.50	0.49	0.36	0.36	0.29	0.24	0.10	0.12	0.12
2007	0.05	1.11	4.16	6.48	5.87	7.05	9.98	9.71	9.83	7.22	6.99	5.64	4.04	3.32	2.77	1.87	1.60	1.42	1.22	1.52	0.73	0.84	0.69	0.65	0.52	0.35	0.23	0.23	0.21	0.15
2008	0.02	1.33	5.37	5.30	6.60	10.61	12.17	12.10	8.71	7.93	6.86	5.09	3.76	3.19	2.40	1.86	1.62	1.41	1.17	1.01	0.92	0.65	0.54	0.56	0.49	0.39	0.34	0.29	0.24	0.17
2009	0.02	0.84	2.43	3.65	6.36	7.78	7.97	5.45	4.55	3.75	2.71	2.14	1.83	1.37	1.21	1.05	0.98	0.83	0.71	0.63	0.57	0.50	0.41	0.35	0.31	0.26	0.24	0.18	0.18	0.13
2010	0.04	0.79	1.97	3.73	4.40	4.68	3.41	2.96	2.48	1.97	1.54	1.32	1.10	0.96	0.84	0.75	0.68	0.55	0.50	0.43	0.42	0.34	0.30	0.24	0.25	0.19	0.17	0.16	0.10	0.09
2011	0.05	0.69	1.83	2.07	2.60	2.14	2.09	1.80	1.41	1.14	1.03	0.85	0.81	0.71	0.62	0.58	0.45	0.44	0.38	0.35	0.29	0.28	0.26	0.24	0.18	0.19	0.15	0.16	0.12	0.10
2012	0.02	0.35	0.71	1.34	1.39	1.39	1.28	1.09	0.88	0.81	0.66	0.60	0.52	0.48	0.43	0.41	0.35	0.32	0.29	0.26	0.24	0.22	0.20	0.19	0.19	0.18	0.15	0.14	0.11	0.09
2013	0.02	0.24	0.84	1.07	1.15	1.12	0.94	0.80	0.72	0.60	0.54	0.48	0.45	0.40	0.36	0.34	0.31	0.29	0.25	0.22	0.21	0.20	0.17	0.16	0.15	0.13	0.12	0.11	0.10	0.08
2014	0.02	0.33	1.06	1.44	1.57	1.24	1.20	1.18	0.99	0.88	0.87	0.67	0.69	0.50	0.51	0.41	0.42	0.39	0.37	0.31	0.27	0.31	0.24	0.25	0.23	0.19	0.16	0.15	0.09	0.10
2015	0.02	0.38	1.11	1.59	1.46	1.30	1.28	1.10	1.05	0.83	0.83	0.81	0.75	0.55	0.45	0.41	0.43	0.37	0.44	0.35	0.31	0.32	0.31	0.25	0.29	0.20	0.22	0.19	0.12	0.07
2016	0.03	0.52	1.36	1.93	1.92	1.67	1.71	1.47	1.52	1.48	1.09	1.06	1.42	0.89	0.87	0.79	0.84	0.67	0.79	0.65	0.54	0.61	0.54	0.56	0.44	0.38	0.38	0.26	0.14	0.14
2017	0.03	0.36	1.25	1.89	2.30	1.73	1.82	1.70	1.63	1.62	1.34	1.53	1.50	1.05	1.01	0.92	1.04	0.85	0.98	0.52	0.80	0.69	0.57	0.55	0.47	0.31	0.31	0.34	0.16	0.15
2018	0.02	0.34	1.29	1.83	1.90	1.79	1.85	1.69	1.87	1.71	1.67	1.46	1.55	1.28	1.24	1.37	1.34	1.19	1.06	0.92	1.11	0.96	0.75	0.75	0.68	0.45	0.36	0.33	0.23	0.11
2019	0.02	0.34	1.26	1.55	1.66	1.65	1.80	1.82	1.69	1.63	1.38	1.49	1.57	1.31	1.18	1.24	1.01	0.86	1.06	0.92	1.04	0.97	0.80	0.61	0.58	0.43	0.38	0.28	0.24	0.11
2020	0.01	0.32	1.06	1.54	1.82	2.05	2.24	1.78	2.12	1.89	1.71	1.66	1.91	1.45	1.42	1.29	1.13	1.19	1.36	1.33	1.37	1.27	0.92	0.80	0.61	0.57	0.55	0.33	0.19	0.10
2021	0.01	0.33	1.01	1.49	1.78	1.81	1.71	1.63	1.63	1.59	1.37	1.33	1.33	1.10	0.82	0.92	0.82	0.79	0.95	0.70	0.64	0.65	0.48	0.47	0.41	0.29	0.31	0.27	0.13	0.10

Conditional Prepayment Rates Fixed Rate 30 Year Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1993	2.99	11.95	5.50	8.73	8.02	15.33	20.61	10.73	16.67	27.99	44.99	31.05	21.64	17.81	10.51	8.59	8.08	8.30	6.96	6.52	7.43	5.57	2.60	1.96	1.37	1.11	1.03	0.81	0.65	0.63
1994	1.89	4.12	6.99	7.08	11.46	15.76	9.55	14.17	22.52	41.17	30.00	21.63	16.07	11.07	8.92	8.29	7.82	7.38	7.71	7.87	5.57	2.76	1.89	1.43	1.17	1.07	0.94	0.73	0.61	0.40
1995	2.07	15.49	9.33	22.02	24.35	10.84	18.98	28.56	39.43	30.94	24.93	17.12	13.10	10.14	6.91	4.84	7.55	4.78	4.22	4.22	2.93	2.88	2.22	1.36	1.15	1.65	0.79	1.08	0.64	0.18
1996	2.13	6.08	17.81	22.63	10.22	18.19	29.94	45.97	35.99	27.41	19.64	13.25	9.60	7.90	7.97	5.95	5.66	7.98	6.33	3.50	2.31	1.48	1.67	1.30	1.29	1.18	0.62	0.84	0.79	0.37
1997	3.27	29.93	27.78	9.84	20.19	32.41	44.73	37.88	31.86	24.00	14.19	11.10	6.16	5.21	5.25	6.26	7.42	6.73	3.07	2.99	2.37	1.85	0.81	1.38	1.16	1.06	1.10	0.54	0.36	0.53
1998	4.45	18.02	8.13	17.94	32.36	53.40	42.41	33.20	22.55	16.01	10.79	9.07	6.77	6.34	6.69	8.52	7.03	4.44	3.22	2.82	2.24	1.81	1.67	1.43	1.04	1.33	1.04	1.10	0.81	0.53
1999	2.70	6.05	13.92	25.94	48.94	39.16	31.46	21.86	14.97	10.88	9.05	6.68	6.60	7.26	9.27	7.51	4.84	3.47	2.71	2.26	1.84	1.71	1.73	1.41	1.21	1.02	0.82	0.61	0.52	0.50
2000	3.60	33.27	36.35	44.70	40.69	32.62	24.72	15.56	9.51	7.40	5.76	4.43	3.12	6.03	5.88	6.28	3.30	3.21	3.14	2.58	2.51	1.93	2.16	1.44	1.21	1.02	1.55	1.03	0.51	0.11
2001	7.40	33.68	54.63	40.72	33.19	23.68	15.69	10.61	8.98	5.85	5.14	4.80	8.36	7.08	5.60	3.48	2.87	2.51	2.01	1.80	1.73	1.75	1.17	1.21	1.08	0.82	1.08	0.61	0.63	0.43
2002	10.78	51.13	37.18	30.24	21.01	14.96	9.93	9.85	6.99	6.09	6.48	10.14	8.29	5.64	4.19	2.88	2.70	2.29	2.08	1.87	1.89	1.54	1.40	1.16	1.14	0.80	0.73	0.66	0.54	0.32
2003	19.33	27.32	27.28	18.82	13.10	8.94	10.51	7.93	7.44	8.95	14.42	9.14	6.09	4.21	3.22	2.93	2.78	2.48	2.23	2.01	1.87	1.68	1.47	1.28	1.20	0.98	0.95	0.79	0.70	0.47
2004	11.42	21.99	16.14	11.81	7.59	7.42	6.15	5.98	8.43	14.23	8.67	6.34	4.20	3.29	3.16	2.80	2.64	2.31	2.22	1.93	1.78	1.58	1.39	1.30	1.11	1.00	0.83	0.77	0.66	0.45
2005	9.36	13.10	10.85	6.73	7.11	5.47	4.78	7.45	13.33	7.68	5.24	3.21	2.69	2.43	2.36	2.10	1.92	1.80	1.52	1.48	1.30	1.12	1.04	0.94	0.89	0.64	0.68	0.60	0.53	0.39
2006	3.94	10.95	7.93	10.17	6.28	4.66	7.37	13.28	8.50	5.42	2.88	2.47	2.52	2.39	2.07	2.00	1.70	1.55	1.33	1.27	1.17	0.97	1.04	0.86	0.72	0.49	0.51	0.35	0.38	0.30
2007	4.01	19.61	17.25	7.53	4.83	6.96	11.04	7.80	4.63	2.30	1.97	2.15	2.18	1.88	2.04	1.84	1.50	1.60	1.36	1.29	1.00	0.83	0.76	0.62	0.49	0.38	0.64	0.31	0.43	0.36
2008	4.24	26.30	8.72	5.30	8.34	13.43	7.87	3.68	2.23	1.68	1.74	1.63	1.65	1.76	1.66	1.71	1.31	1.26	1.19	1.08	0.91	0.81	0.89	0.68	0.68	0.52	0.38	0.41	0.42	0.37
2009	3.08	8.25	6.91	15.41	18.88	6.70	4.21	2.41	2.00	2.08	2.00	1.96	1.90	1.93	1.80	1.80	1.58	1.50	1.31	1.18	1.08	0.97	0.86	0.76	0.70	0.61	0.55	0.48	0.50	0.37
2010	2.82	5.70	11.08	16.50	7.81	6.23	3.68	2.84	2.72	2.58	2.47	2.43	2.34	2.25	2.20	1.92	1.85	1.68	1.47	1.33	1.18	1.08	1.00	0.87	0.77	0.69	0.65	0.58	0.51	0.43
2011	0.48	6.80	15.29	9.63	8.38	5.14	3.95	3.85	3.55	3.20	3.06	2.98	2.86	2.77	2.46	2.31	2.12	1.82	1.68	1.53	1.36	1.28	1.19	1.04	0.94	0.86	0.83	0.75	0.61	0.51
2012	0.85	11.17	9.60	8.04	5.51	4.63	4.48	3.99	3.61	3.08	3.08	2.89	2.88	2.60	2.37	2.19	1.90	1.79	1.58	1.49	1.37	1.19	1.11	1.03	0.95	0.88	0.85	0.73	0.66	0.55
2013	1.54	6.71	7.36	5.11	4.55	4.61	4.17	3.75	3.21	2.92	2.85	2.81	2.57	2.44	2.18	1.92	1.77	1.62	1.52	1.40	1.19	1.12	1.02	0.95	0.89	0.83	0.82	0.72	0.67	0.53
2014	2.91	10.21	7.82	6.76	7.11	6.63	5.62	4.81	4.32	3.77	3.51	3.05	2.84	2.53	2.05	2.10	1.74	1.58	1.49	1.27	1.16	1.09	1.03	0.90	0.72	0.71	0.68	0.66	0.60	0.42
2015	5.83	12.47	10.93	10.41	10.34	9.42	8.03	6.72	6.22	5.36	4.41	3.88	3.21	2.60	2.43	1.88	1.66	1.72	1.49	1.33	1.27	1.27	1.10	0.97	0.90	0.79	0.79	0.74	0.65	0.43
2016	7.65	19.71	17.80	15.47	15.38	12.71	10.73	9.02	7.67	6.06	5.09	4.13	4.23	3.14	2.39	2.72	2.05	2.10	2.10	1.98	2.11	1.76	1.50	1.07	0.95	1.17	0.96	0.83	0.74	0.34
2017	7.50	23.96	21.41	18.69	17.81	15.35	12.61	10.95	9.18	7.36	5.77	4.90	5.04	3.39	3.26	2.71	2.82	2.63	2.72	2.84	2.40	1.99	2.01	1.14	0.95	1.12	1.14	0.88	0.72	0.52
2018	8.08	23.03	21.12	17.85	16.48	14.25	12.80	10.84	9.34	7.57	6.48	5.58	4.66	4.09	3.67	3.31	3.02	2.33	2.02	2.10	1.87	1.31	1.51	1.20	1.19	0.98	0.88	0.80	0.62	0.51
2019	9.26	24.26	21.06	17.50	16.49	15.40	12.88	10.02	8.31	6.45	5.93	4.98	4.62	4.02	3.66	3.08	2.63	2.34	2.13	2.10	1.91	1.66	1.59	1.30	0.99	1.06	0.94	0.72	0.72	0.51
2020	9.78	27.33	23.79	19.66	19.23	16.06	12.71	10.92	8.46	7.43	5.95	5.19	4.62	3.39	2.85	2.63	2.21	2.09	2.00	1.90	1.69	1.52	1.57	1.16	1.08	0.97	0.82	0.82	0.81	0.52
2021	10.20	27.38	24.64	22.69	19.59	16.38	12.98	10.15	9.01	7.24	6.34	5.37	4.37	3.59	3.25	2.91	2.70	2.41	2.42	2.29	2.13	1.88	1.75	1.36	1.26	0.95	0.94	0.85	0.72	0.58

Cumulative Claim Rates Fixed Rate 30 Year Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1993	0.01	0.20	0.80	1.67	2.78	3.71	4.33	4.70	4.88	4.99	5.05	5.09	5.10	5.11	5.12	5.12	5.13	5.14	5.15	5.16	5.17	5.18	5.20	5.21	5.22	5.24	5.24	5.25	5.25	5.26
1994	0.01	0.32	1.07	2.06	3.07	3.81	4.26	4.53	4.69	4.79	4.85	4.89	4.91	4.92	4.93	4.94	4.97	4.98	5.00	5.02	5.05	5.08	5.10	5.12	5.13	5.14	5.15	5.16	5.17	5.18
1995	0.02	0.43	1.59	3.06	4.09	4.83	5.26	5.49	5.67	5.78	5.83	5.88	5.91	5.91	5.93	5.95	5.99	6.01	6.03	6.06	6.09	6.11	6.13	6.14	6.15	6.16	6.17	6.18	6.20	6.21
1996	0.02	0.51	1.86	3.22	4.12	4.57	4.84	5.04	5.14	5.19	5.24	5.27	5.29	5.30	5.33	5.35	5.37	5.40	5.43	5.47	5.50	5.52	5.54	5.55	5.56	5.57	5.58	5.58	5.59	5.59
1997	0.02	0.64	1.81	2.82	3.43	3.78	4.01	4.12	4.18	4.22	4.24	4.26	4.29	4.31	4.33	4.35	4.36	4.39	4.41	4.43	4.44	4.46	4.48	4.48	4.48	4.49	4.49	4.49	4.50	4.50
1998	0.00	0.21	0.83	1.40	1.81	2.11	2.31	2.40	2.45	2.48	2.50	2.53	2.57	2.60	2.62	2.65	2.69	2.74	2.77	2.79	2.81	2.82	2.83	2.84	2.85	2.85	2.86	2.87	2.87	2.87
1999	0.01	0.26	0.71	1.21	1.67	1.94	2.10	2.19	2.24	2.29	2.34	2.39	2.43	2.49	2.55	2.62	2.70	2.74	2.78	2.81	2.83	2.85	2.87	2.88	2.89	2.90	2.91	2.91	2.92	2.93
2000	0.02	0.37	1.13	1.91	2.58	2.91	3.04	3.14	3.23	3.27	3.32	3.40	3.46	3.54	3.60	3.68	3.75	3.78	3.83	3.86	3.87	3.88	3.88	3.88	3.89	3.91	3.92	3.92	3.93	3.93
2001	0.00	0.19	0.97	1.69	2.14	2.41	2.58	2.72	2.84	3.00	3.13	3.23	3.34	3.48	3.62	3.69	3.75	3.80	3.83	3.86	3.88	3.90	3.91	3.93	3.94	3.95	3.96	3.97	3.97	3.98
2002	0.01	0.38	1.16	1.74	2.10	2.34	2.54	2.73	2.94	3.14	3.30	3.49	3.70	3.93	4.05	4.14	4.22	4.28	4.32	4.35	4.38	4.41	4.43	4.45	4.46	4.48	4.49	4.50	4.51	4.52
2003	0.01	0.47	1.20	1.72	2.12	2.50	2.89	3.36	3.76	4.17	4.59	5.10	5.56	5.82	6.01	6.16	6.28	6.37	6.45	6.51	6.57	6.61	6.66	6.70	6.73	6.76	6.78	6.80	6.82	6.84
2004	0.14	0.89	1.66	2.32	2.99	3.70	4.58	5.38	6.18	7.01	8.04	8.90	9.37	9.72	9.99	10.18	10.34	10.48	10.59	10.69	10.76	10.84	10.91	10.96	11.01	11.06	11.10	11.13	11.16	11.18
2005	0.11	0.71	1.94	3.33	4.87	6.68	8.29	9.90	11.52	12.97	14.20	14.92	15.53	16.03	16.35	16.64	16.86	17.01	17.15	17.28	17.37	17.46	17.52	17.59	17.63	17.68	17.72	17.74	17.77	17.79
2006	0.06	1.07	3.01	5.53	8.51	10.90	13.41	16.01	18.08	19.88	20.94	21.82	22.55	23.00	23.44	23.76	23.98	24.11	24.25	24.39	24.48	24.57	24.66	24.72	24.78	24.83	24.86	24.88	24.90	24.92
2007	0.05	1.12	4.30	8.19	11.21	14.45	18.39	21.41	23.92	25.50	26.88	27.89	28.56	29.07	29.48	29.74	29.95	30.13	30.29	30.47	30.56	30.65	30.73	30.80	30.86	30.90	30.92	30.95	30.97	31.00
2008	0.02	1.30	5.04	8.20	11.72	16.53	20.71	24.02	26.03	27.66	28.93	29.79	30.38	30.85	31.19	31.44	31.66	31.83	31.98	32.10	32.21	32.28	32.34	32.41	32.46	32.50	32.54	32.57	32.60	32.63
2009	0.02	0.84	3.00	5.93	10.05	13.82	17.11	19.09	20.61	21.78	22.57	23.17	23.66	24.01	24.32	24.57	24.80	24.99	25.15	25.29	25.41	25.52	25.60	25.68	25.74	25.79	25.84	25.88	25.92	25.95
2010	0.04	0.81	2.61	5.58	8.37	10.96	12.65	14.00	15.08	15.88	16.48	16.98	17.38	17.71	18.00	18.24	18.45	18.62	18.78	18.90	19.03	19.13	19.21	19.28	19.35	19.41	19.46	19.50	19.53	19.57
2011	0.05	0.74	2.44	4.03	5.78	7.07	8.23	9.18	9.87	10.41	10.87	11.23	11.57	11.86	12.09	12.31	12.47	12.63	12.76	12.88	12.98	13.07	13.15	13.23	13.29	13.35	13.40	13.45	13.49	13.53
2012	0.02	0.37	1.00	2.07	3.06	3.98	4.78	5.43	5.92	6.36	6.70	6.99	7.24	7.47	7.66	7.83	7.98	8.11	8.23	8.33	8.43	8.51	8.59	8.66	8.73	8.80	8.86	8.91	8.95	8.99
2013	0.02	0.25	1.03	1.93	2.85	3.68	4.34	4.88	5.34	5.70	6.02	6.30	6.55	6.76	6.94	7.11	7.27	7.41	7.53	7.63	7.72	7.81	7.89	7.96	8.03	8.09	8.14	8.19	8.23	8.27
2014	0.02	0.34	1.27	2.41	3.56	4.39	5.12	5.79	6.32	6.76	7.18	7.49	7.79	8.00	8.21	8.38	8.54	8.69	8.83	8.94	9.04	9.14	9.23	9.31	9.39	9.45	9.51	9.56	9.59	9.62
2015	0.02	0.38	1.29	2.44	3.37	4.09	4.73	5.22	5.65	5.97	6.27	6.54	6.78	6.95	7.09	7.21	7.33	7.43	7.55	7.64	7.73	7.81	7.89	7.95	8.02	8.07	8.12	8.17	8.20	8.22
2016	0.03	0.52	1.53	2.67	3.62	4.29	4.88	5.32	5.73	6.09	6.33	6.55	6.83	6.99	7.14	7.27	7.41	7.51	7.63	7.72	7.80	7.88	7.95	8.02	8.07	8.12	8.17	8.20	8.22	8.24
2017	0.03	0.36	1.24	2.26	3.25	3.84	4.35	4.76	5.10	5.40	5.62	5.85	6.07	6.21	6.33	6.44	6.56	6.66	6.76	6.81	6.89	6.95	7.00	7.05	7.09	7.12	7.15	7.18	7.19	7.20
2018	0.02	0.34	1.25	2.24	3.07	3.71	4.26	4.68	5.09	5.41	5.70	5.93	6.16	6.32	6.48	6.64	6.79	6.91	7.02	7.11	7.21	7.29	7.35	7.42	7.47	7.51	7.54	7.56	7.58	7.60
2019	0.02	0.33	1.20	2.02	2.73	3.30	3.81	4.26	4.61	4.92	5.15	5.39	5.62	5.79	5.94	6.09	6.20	6.29	6.40	6.49	6.58	6.66	6.73	6.78	6.84	6.87	6.90	6.93	6.95	6.96
2020	0.01	0.31	1.00	1.75	2.45	3.07	3.61	3.98	4.36	4.66	4.90	5.11	5.34	5.50	5.64	5.77	5.87	5.97	6.09	6.19	6.29	6.38	6.45	6.51	6.55	6.58	6.62	6.64	6.66	6.67
2021	0.01	0.32	0.97	1.69	2.33	2.85	3.24	3.56	3.84	4.08	4.27	4.44	4.59	4.71	4.79	4.88	4.95	5.02	5.10	5.15	5.20	5.25	5.28	5.32	5.35	5.36	5.38	5.40	5.41	5.42

Cumulative Prepayment Rates Fixed Rate 30 Year Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1993	3	14.63	19.34	26.35	32.15	42.19	53.39	57.95	64.22	72.91	82.89	86.64	88.43	89.58	90.14	90.55	90.91	91.25	91.51	91.77	92.18	92.33	92.40	92.45	92.48	92.51	92.53	92.55	92.56	92.58
1994	1.90	5.97	12.54	18.69	27.82	38.76	44.28	51.61	61.54	75.52	81.43	84.40	86.12	87.12	87.84	88.45	88.98	89.45	89.91	90.44	90.81	90.92	91.00	91.06	91.10	91.14	91.18	91.20	91.23	91.25
1995	2.08	17.28	24.98	41.21	54.82	59.29	66.14	74.34	82.32	86.04	88.09	89.13	89.78	90.21	90.49	90.66	90.94	91.09	91.25	91.38	91.45	91.51	91.56	91.59	91.61	91.65	91.66	91.68	91.69	91.70
1996	2.14	8.11	24.45	41.17	46.89	55.85	67.75	80.42	85.67	88.20	89.50	90.21	90.64	90.97	91.28	91.48	91.67	91.92	92.10	92.19	92.24	92.27	92.31	92.34	92.36	92.39	92.40	92.42	92.43	92.44
1997	3.28	32.31	50.98	55.64	64.07	74.63	84.33	88.76	91.03	92.18	92.69	93.03	93.20	93.33	93.46	93.60	93.75	93.88	93.94	93.99	94.03	94.05	94.06	94.08	94.09	94.11	94.12	94.13	94.13	94.14
1998	4.46	21.72	28.09	40.91	59.65	80.33	87.80	91.10	92.57	93.37	93.82	94.16	94.38	94.58	94.77	95.00	95.17	95.27	95.33	95.39	95.43	95.46	95.49	95.51	95.53	95.55	95.57	95.58	95.59	95.60
1999	2.71	8.63	21.38	41.67	69.77	80.99	86.38	88.91	90.25	91.08	91.68	92.09	92.46	92.84	93.28	93.60	93.79	93.91	94.00	94.08	94.14	94.19	94.24	94.28	94.31	94.34	94.36	94.38	94.39	94.41
2000	3.61	35.75	59.02	76.89	85.55	89.43	91.33	92.21	92.66	92.96	93.18	93.34	93.44	93.63	93.80	93.97	94.05	94.12	94.19	94.23	94.28	94.31	94.35	94.37	94.39	94.41	94.43	94.45	94.46	94.46
2001	7.42	38.72	72.21	83.17	88.22	90.51	91.63	92.24	92.70	92.96	93.17	93.35	93.64	93.86	94.01	94.09	94.16	94.21	94.25	94.29	94.32	94.36	94.38	94.40	94.41	94.43	94.45	94.46	94.47	94.47
2002	10.84	56.60	72.66	80.61	84.33	86.37	87.50	88.49	89.11	89.60	90.07	90.75	91.24	91.53	91.72	91.84	91.96	92.05	92.13	92.20	92.26	92.31	92.36	92.40	92.43	92.46	92.48	92.50	92.52	92.53
2003	19.43	41.55	57.44	65.26	69.61	72.16	74.84	76.62	78.12	79.76	82.10	83.33	84.04	84.49	84.81	85.09	85.34	85.56	85.74	85.91	86.05	86.18	86.28	86.37	86.45	86.52	86.58	86.63	86.68	86.72
2004	11.60	31.10	42.13	48.81	52.54	55.87	58.38	60.62	63.52	67.86	70.07	71.48	72.32	72.94	73.50	73.98	74.42	74.79	75.13	75.42	75.66	75.87	76.06	76.23	76.37	76.49	76.59	76.68	76.77	76.84
2005	9.48	21.39	29.89	34.51	38.96	42.05	44.52	48.08	53.70	56.41	58.03	58.94	59.66	60.28	60.86	61.36	61.80	62.21	62.55	62.86	63.12	63.33	63.52	63.69	63.85	63.96	64.07	64.17	64.26	64.33
2006	3.96	14.52	21.24	28.97	33.10	35.84	39.81	46.06	49.31	51.10	51.95	52.64	53.30	53.90	54.39	54.85	55.24	55.57	55.86	56.14	56.36	56.54	56.73	56.88	57.01	57.09	57.18	57.24	57.30	57.36
2007	4.03	22.89	36.06	40.57	43.06	46.27	50.64	53.07	54.26	54.77	55.16	55.56	55.92	56.23	56.53	56.80	57.01	57.23	57.41	57.57	57.69	57.88	57.95	58.01	58.05	58.12	58.15	58.21	58.26	
2008	4.25	29.52	35.58	38.74	43.21	49.30	52.01	53.02	53.54	53.89	54.21	54.49	54.76	55.02	55.26	55.50	55.67	55.84	55.99	56.13	56.24	56.33	56.43	56.51	56.59	56.65	56.69	56.74	56.79	56.83
2009	3.09	11.14	17.24	29.65	41.88	45.12	46.86	47.74	48.41	49.06	49.65	50.20	50.72	51.22	51.67	52.11	52.49	52.84	53.13	53.40	53.63	53.84	54.02	54.19	54.33	54.46	54.58	54.68	54.79	54.88
2010	2.85	8.41	18.54	31.61	36.55	40.01	41.82	43.13	44.31	45.37	46.33	47.25	48.10	48.89	49.63	50.27	50.86	51.39	51.84	52.25	52.59	52.91	53.20	53.45	53.67	53.87	54.05	54.22	54.37	54.52
2011	0.49	7.28	21.42	28.81	34.47	37.57	39.77	41.79	43.55	45.06	46.44	47.73	48.92	50.03	50.99	51.85	52.63	53.28	53.87	54.40	54.86	55.28	55.67	56.01	56.32	56.60	56.87	57.12	57.34	57.55
2012	0.86	12.03	20.52	26.88	30.83	33.92	36.73	39.09	41.11	42.77	44.36	45.79	47.17	48.38	49.45	50.40	51.22	51.96	52.61	53.21	53.76	54.23	54.66	55.06	55.42	55.76	56.08	56.36	56.63	56.89
2013	1.55	8.22	15.01	19.33	22.95	26.40	29.35	31.87	33.92	35.72	37.42	39.03	40.47	41.78	42.93	43.91	44.81	45.61	46.34	47.01	47.57	48.09	48.55	48.98	49.38	49.75	50.12	50.44	50.76	51.05
2014	2.94	12.89	19.70	25.06	30.24	34.65	38.09	40.84	43.16	45.07	46.78	48.20	49.46	50.56	51.42	52.29	52.99	53.61	54.19	54.68	55.11	55.51	55.88	56.21	56.48	56.72	56.95	57.18	57.40	57.59
2015	5.86	17.64	26.65	34.19	40.77	46.07	50.10	53.15	55.75	57.83	59.44	60.78	61.82	62.64	63.39	63.94	64.43	64.92	65.33	65.70	66.04	66.38	66.67	66.93	67.17	67.37	67.58	67.78	67.96	68.10
2016	7.67	25.92	39.04	48.26	55.84	61.01	64.74	67.48	69.57	71.07	72.23	73.12	73.97	74.58	75.02	75.51	75.87	76.22	76.55	76.86	77.18	77.45	77.67	77.83	77.97	78.14	78.28	78.40	78.51	78.57
2017	7.53	29.74	44.75	54.89	62.55	67.83	71.42	74.08	76.03	77.43	78.43	79.21	79.96	80.44	80.88	81.23	81.57	81.88	82.19	82.50	82.76	82.97	83.17	83.29	83.38	83.50	83.61	83.70	83.78	83.84
2018	8.11	29.34	44.25	54.02	61.26	66.37	70.23	73.02	75.14	76.66	77.84	78.78	79.50	80.09	80.59	81.02	81.39	81.66	81.89	82.12	82.32	82.46	82.62	82.73	82.86	82.95	83.04	83.13	83.19	83.25
2019	9.30	31.35	45.76	55.05	62.15	67.58	71.35	73.86	75.70	76.98	78.08	78.93	79.65	80.25	80.77	81.18	81.51	81.80	82.05	82.30	82.51	82.69	82.86	82.99	83.10	83.21	83.30	83.38	83.46	83.52
2020	9.81	34.52	50.05	59.70	67.12	72.02	75.21	77.53	79.10	80.34	81.23	81.95	82.54	82.94	83.27	83.56	83.79	84.01	84.21	84.39	84.54	84.67	84.81	84.91	84.99	85.07	85.14	85.21	85.28	85.34
2021	10.24	34.87	50.87	61.82	68.98	73.68	76.74	78.77	80.37	81.52	82.43	83.14	83.68	84.09	84.45	84.76	85.04	85.28	85.52	85.73	85.92	86.08	86.23	86.35	86.46	86.54	86.63	86.70	86.77	86.83

Conditional Claim Rates Fixed Rate 15 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1999	0.00	0.07	0.22	0.33	0.48	0.43	0.40	0.16	0.20	0.19	0.16	0.06	0.09	0.13	0.10
2000	0.00	0.11	0.57	1.22	1.76	0.92	0.88	0.41	0.37	0.50	0.57	0.51	0.00	0.13	0.34
2001	0.00	0.12	0.54	0.97	0.91	0.92	0.72	0.48	0.80	0.33	0.68	0.26	0.22	0.30	0.48
2002	0.02	0.14	0.49	0.62	0.60	0.35	0.31	0.21	0.39	0.36	0.36	0.39	0.30	0.45	0.11
2003	0.01	0.16	0.32	0.32	0.20	0.22	0.42	0.38	0.42	0.46	0.61	0.49	0.57	0.31	0.22
2004	0.04	0.17	0.26	0.36	0.42	0.45	0.51	0.50	0.64	0.54	1.03	0.73	0.38	0.27	0.32
2005	0.02	0.62	1.67	1.47	1.61	1.59	1.33	0.83	1.51	1.45	0.98	1.05	1.38	0.94	0.70
2006	0.05	1.29	2.18	2.70	2.69	1.98	2.22	2.78	2.58	2.03	1.55	1.97	1.89	1.12	0.66
2007	0.01	0.82	2.24	2.56	2.08	3.25	4.35	3.73	3.31	2.01	1.85	2.03	1.52	1.01	0.83
2008	0.01	0.35	1.26	1.48	1.95	3.39	2.94	2.73	1.71	1.47	1.66	1.22	1.05	0.83	0.65
2009	0.01	0.17	0.26	0.56	1.23	1.10	1.00	0.58	0.58	0.55	0.37	0.35	0.26	0.18	0.15
2010	0.00	0.04	0.15	0.35	0.43	0.37	0.24	0.23	0.24	0.16	0.14	0.16	0.10	0.10	0.07
2011	0.00	0.03	0.14	0.20	0.24	0.16	0.16	0.16	0.14	0.15	0.12	0.11	0.10	0.08	0.06
2012	0.00	0.03	0.09	0.11	0.09	0.07	0.07	0.07	0.07	0.06	0.07	0.05	0.07	0.05	0.07
2013	0.00	0.02	0.12	0.08	0.12	0.10	0.08	0.09	0.09	0.08	0.06	0.07	0.08	0.06	0.07
2014	0.00	0.04	0.19	0.20	0.23	0.31	0.14	0.28	0.09	0.16	0.08	0.07	0.14	0.03	0.03
2015	0.00	0.16	0.27	0.39	0.35	0.37	0.28	0.18	0.21	0.14	0.10	0.15	0.07	0.31	0.10
2016	0.01	0.14	0.64	0.60	0.53	0.61	0.33	0.43	0.37	0.29	0.28	0.24	0.28	0.09	0.19
2017	0.00	0.08	0.57	0.56	0.51	0.47	0.71	0.54	0.36	0.24	0.31	0.38	0.32	0.14	0.04
2018	0.00	0.12	0.52	0.65	0.37	0.40	0.45	0.38	0.31	0.32	0.25	0.21	0.26	0.14	0.06
2019	0.01	0.17	0.41	0.44	0.49	0.30	0.27	0.34	0.29	0.30	0.20	0.31	0.18	0.14	0.09
2020	0.00	0.08	0.45	0.62	0.53	0.39	0.41	0.18	0.33	0.23	0.27	0.38	0.21	0.12	0.15
2021	0.03	0.16	0.47	0.47	0.26	0.48	0.37	0.38	0.44	0.24	0.22	0.32	0.18	0.38	0.08

Conditional Prepayment Rates Fixed Rate 15 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1999	0.869	3.511	9.776	17.26	30	22.08	17.77	13.92	10.9	9.099	7.954	7.172	9.845	11.54	17.49
2000	0.78	18.19	29.05	36.88	25.60	21.10	16.25	10.76	8.41	7.73	6.95	6.66	7.38	10.59	15.11
2001	2.24	14.52	38.69	29.39	23.62	15.29	12.73	11.34	7.25	8.63	7.41	8.74	10.08	16.19	19.79
2002	2.26	26.90	26.58	20.88	16.70	12.72	10.31	8.08	7.51	7.03	7.72	10.13	15.54	19.40	15.88
2003	4.68	15.86	19.10	15.72	12.78	10.30	8.93	8.70	7.97	9.14	10.20	16.45	20.11	17.99	14.96
2004	4.90	14.70	13.64	11.63	8.75	8.05	7.45	6.81	8.23	9.75	15.46	19.15	17.36	16.07	12.73
2005	5.29	11.33	10.87	9.80	8.19	7.16	7.64	7.71	9.15	11.53	13.53	11.82	12.41	10.95	9.19
2006	3.70	10.62	11.66	12.46	9.25	7.55	8.09	9.92	9.69	11.78	10.89	9.79	8.96	9.65	8.98
2007	3.59	12.48	16.58	9.98	7.84	7.82	9.91	9.54	9.80	9.57	9.53	8.95	9.56	10.38	9.32
2008	1.51	17.61	13.39	11.63	13.26	15.55	10.71	9.11	8.81	8.62	8.83	10.35	10.34	9.70	10.38
2009	4.41	7.62	12.73	17.48	21.16	11.94	9.54	8.72	8.60	9.26	9.89	11.04	11.61	11.68	10.95
2010	0.92	7.94	15.46	19.98	12.56	9.66	7.86	7.74	8.96	9.90	10.59	11.07	11.89	12.24	11.58
2011	0.94	14.14	19.27	13.00	10.22	6.56	6.15	7.40	8.32	9.52	9.76	10.89	11.07	12.24	11.42
2012	1.60	10.82	11.52	10.58	5.59	4.32	5.52	6.85	7.98	8.89	9.86	10.74	12.14	12.87	12.39
2013	1.12	6.58	8.07	5.50	3.83	4.32	4.87	6.33	7.06	7.99	9.23	10.63	11.55	12.70	11.88
2014	1.37	6.32	6.85	5.68	5.66	5.81	6.57	8.63	9.20	10.25	11.85	11.38	12.67	13.32	12.77
2015	1.03	4.32	5.91	7.67	6.57	5.99	7.28	6.80	10.03	10.74	11.48	12.29	10.88	13.69	11.11
2016	0.80	5.00	8.50	8.67	7.75	6.48	7.97	7.94	10.59	11.08	11.00	12.43	11.89	12.40	11.78
2017	0.64	5.43	9.16	9.13	7.86	7.16	8.52	9.16	10.52	11.54	12.46	12.15	12.27	12.45	11.61
2018	0.83	5.05	8.04	8.74	7.76	6.80	8.07	8.59	10.03	9.85	12.27	11.70	12.45	12.67	11.83
2019	0.93	5.24	8.00	8.39	7.19	7.09	7.52	7.87	9.27	10.56	10.80	11.63	12.07	12.93	12.35
2020	1.06	5.39	8.04	8.95	8.53	7.25	7.45	7.77	10.02	10.63	11.70	12.98	12.32	11.27	11.79
2021	0.83	6.32	9.50	10.13	8.07	7.54	9.05	8.85	11.29	11.65	12.47	12.89	12.22	13.93	13.28

Cumulative Claim Rates Fixed Rate 15 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1999	0.00	0.08	0.29	0.58	0.92	1.13	1.28	1.33	1.38	1.42	1.46	1.47	1.48	1.50	1.53
2000	0.00	0.11	0.58	1.28	1.89	2.13	2.29	2.36	2.41	2.48	2.55	2.60	2.60	2.62	2.65
2001	0.00	0.12	0.58	1.08	1.40	1.64	1.80	1.89	2.02	2.07	2.17	2.20	2.23	2.26	2.31
2002	0.02	0.16	0.51	0.83	1.07	1.19	1.28	1.33	1.43	1.51	1.58	1.65	1.71	1.77	1.79
2003	0.01	0.16	0.42	0.63	0.74	0.84	1.02	1.17	1.32	1.47	1.65	1.78	1.89	1.95	1.99
2004	0.04	0.21	0.42	0.67	0.93	1.18	1.44	1.68	1.96	2.18	2.55	2.77	2.86	2.92	2.97
2005	0.02	0.62	2.02	3.10	4.14	5.08	5.78	6.19	6.87	7.44	7.78	8.09	8.44	8.65	8.79
2006	0.05	1.33	3.22	5.23	6.92	8.01	9.12	10.36	11.38	12.06	12.52	13.03	13.49	13.75	13.91
2007	0.01	0.83	2.74	4.51	5.76	7.52	9.61	11.15	12.30	12.92	13.43	13.92	14.25	14.45	14.61
2008	0.01	0.36	1.40	2.43	3.61	5.35	6.57	7.53	8.07	8.48	8.90	9.17	9.39	9.55	9.66
2009	0.01	0.18	0.42	0.86	1.65	2.19	2.61	2.83	3.03	3.21	3.31	3.40	3.46	3.50	3.53
2010	0.00	0.04	0.18	0.46	0.73	0.93	1.05	1.15	1.25	1.31	1.36	1.41	1.43	1.46	1.48
2011	0.00	0.03	0.15	0.29	0.43	0.52	0.60	0.67	0.73	0.80	0.84	0.88	0.91	0.93	0.95
2012	0.00	0.03	0.11	0.20	0.26	0.31	0.35	0.39	0.43	0.46	0.50	0.52	0.55	0.57	0.59
2013	0.00	0.03	0.14	0.21	0.31	0.39	0.45	0.51	0.57	0.62	0.66	0.69	0.73	0.76	0.79
2014	0.00	0.04	0.22	0.39	0.58	0.82	0.92	1.10	1.16	1.25	1.29	1.32	1.38	1.39	1.41
2015	0.00	0.17	0.43	0.78	1.07	1.36	1.56	1.68	1.81	1.89	1.94	2.00	2.03	2.14	2.19
2016	0.01	0.15	0.76	1.27	1.69	2.12	2.34	2.61	2.81	2.95	3.08	3.17	3.27	3.30	3.35
2017	0.00	0.08	0.62	1.11	1.50	1.83	2.29	2.61	2.80	2.91	3.05	3.18	3.28	3.32	3.33
2018	0.00	0.12	0.62	1.19	1.48	1.76	2.06	2.30	2.48	2.64	2.75	2.83	2.91	2.95	2.97
2019	0.01	0.18	0.58	0.96	1.35	1.57	1.75	1.96	2.13	2.28	2.37	2.49	2.56	2.61	2.64
2020	0.00	0.08	0.51	1.04	1.46	1.73	2.00	2.11	2.28	2.40	2.52	2.66	2.72	2.76	2.81
2021	0.03	0.19	0.64	1.03	1.23	1.55	1.78	1.99	2.20	2.31	2.40	2.51	2.56	2.66	2.67

Cumulative Prepayment Rates Fixed Rate 15 Year Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1999	0.884	4.436	13.96	28.99	50.59	61.53	68.33	72.68	75.66	77.96	79.92	81.39	83.29	85.42	90.2
2000	0.79	19.13	42.89	64.10	73.12	78.50	81.72	83.49	84.75	85.90	86.86	87.63	88.44	89.56	91.31
2001	2.28	16.77	49.52	64.42	72.74	76.78	79.61	81.79	83.05	84.43	85.54	86.70	87.94	89.82	91.82
2002	2.30	29.14	48.24	59.14	65.97	70.26	73.29	75.42	77.24	78.87	80.59	82.55	85.39	88.31	90.39
2003	4.78	20.20	35.72	45.95	52.93	57.84	61.67	65.04	67.88	70.87	73.96	78.41	82.84	86.09	88.60
2004	5.03	19.28	30.48	38.68	44.12	48.70	52.58	55.83	59.51	63.61	69.43	75.29	79.56	83.01	85.54
2005	5.46	16.37	25.58	32.83	38.23	42.48	46.63	50.46	54.63	59.42	64.22	67.80	71.20	73.85	76.08
2006	3.76	14.14	24.15	33.36	39.15	43.33	47.37	51.82	55.69	59.81	63.03	65.57	67.67	69.77	71.77
2007	3.64	15.84	29.91	36.73	41.44	45.70	50.48	54.43	57.96	60.96	63.59	65.82	67.96	70.11	72.04
2008	1.53	19.19	30.10	38.21	46.29	54.30	58.76	62.04	64.84	67.31	69.58	71.96	74.11	75.96	77.89
2009	4.50	11.96	23.34	36.97	50.44	56.33	60.42	63.77	66.78	69.73	72.57	75.43	78.13	80.62	82.91
2010	0.94	9.00	23.36	38.98	46.79	52.01	55.83	59.31	63.03	66.77	70.37	73.75	77.03	80.12	83.00
2011	0.96	15.25	31.91	40.97	47.11	50.66	53.78	57.30	60.97	64.83	68.40	72.03	75.37	78.77	81.90
2012	1.64	12.56	22.91	31.23	35.16	38.05	41.59	45.75	50.26	54.90	59.61	64.26	69.03	73.60	77.91
2013	1.15	7.85	15.45	20.19	23.32	26.73	30.41	34.99	39.78	44.83	50.19	55.85	61.45	67.11	72.32
2014	1.40	7.82	14.27	19.27	23.95	28.49	33.31	39.19	44.95	50.83	56.87	62.03	67.19	72.09	76.65
2015	1.06	5.43	11.15	18.07	23.52	28.16	33.47	38.09	44.38	50.48	56.29	61.85	66.23	71.35	75.36
2016	0.81	5.89	14.03	21.57	27.67	32.38	37.78	42.74	48.81	54.44	59.41	64.45	68.74	72.84	76.62
2017	0.65	6.19	14.98	22.85	28.97	34.08	39.75	45.30	51.08	56.71	62.05	66.63	70.76	74.51	78.10
2018	0.84	5.99	13.70	21.33	27.50	32.47	37.97	43.34	49.06	54.11	59.76	64.54	69.06	73.25	77.05
2019	0.95	6.27	13.92	21.25	26.99	32.22	37.37	42.38	47.78	53.39	58.49	63.44	68.03	72.46	76.64
2020	1.08	6.54	14.22	22.03	28.78	34.00	38.97	43.74	49.44	54.87	60.18	65.43	69.74	73.37	77.16
2021	0.85	7.27	16.28	24.89	31.03	36.32	42.16	47.36	53.38	58.87	64.05	68.72	72.62	76.70	80.44

Conditional Claim Rates Fixed Rate 15 Year Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1993	0.00	0.04	0.10	0.15	0.18	0.14	0.12	0.13	0.08	0.06	0.03	0.02	0.01	0.02	0.02
1994	0.00	0.06	0.20	0.25	0.27	0.22	0.18	0.09	0.09	0.06	0.04	0.05	0.02	0.02	0.02
1995	0.01	0.14	0.44	0.61	0.48	0.39	0.45	0.28	0.20	0.20	0.00	0.21	0.00	0.00	0.02
1996	0.00	0.05	0.15	0.32	0.34	0.32	0.23	0.12	0.23	0.07	0.06	0.03	0.00	0.01	0.00
1997	0.00	0.15	0.20	0.38	0.33	0.19	0.15	0.14	0.23	0.05	0.03	0.00	0.08	0.00	0.02
1998	0.00	0.02	0.14	0.14	0.22	0.11	0.15	0.14	0.03	0.04	0.05	0.07	0.15	0.03	0.04
1999	0.00	0.03	0.08	0.08	0.16	0.13	0.12	0.09	0.07	0.02	0.08	0.14	0.04	0.08	0.11
2000	0.00	0.08	0.13	0.30	0.28	0.20	0.20	0.32	0.30	0.43	0.36	0.00	0.09	0.51	0.03
2001	0.00	0.04	0.10	0.22	0.59	0.33	0.19	0.12	0.30	0.45	0.32	0.18	0.29	0.24	0.08
2002	0.00	0.04	0.22	0.17	0.19	0.13	0.14	0.15	0.11	0.25	0.14	0.21	0.26	0.35	0.22
2003	0.00	0.05	0.12	0.16	0.09	0.15	0.14	0.29	0.22	0.21	0.37	0.39	0.36	0.20	0.22
2004	0.02	0.08	0.17	0.14	0.15	0.23	0.34	0.32	0.30	0.28	0.46	0.39	0.22	0.21	0.24
2005	0.01	0.10	0.12	0.20	0.40	0.47	0.38	0.43	0.40	0.47	0.42	0.24	0.21	0.28	0.33
2006	0.00	0.05	0.09	0.47	0.61	0.34	0.71	0.54	0.58	0.75	0.28	0.29	0.25	0.14	0.30
2007	0.00	0.13	0.28	0.97	0.36	0.37	1.23	1.80	1.36	0.27	0.89	1.27	0.27	0.26	0.42
2008	0.00	0.09	0.59	0.86	1.25	1.96	2.70	2.22	1.03	0.97	1.22	0.30	0.47	0.29	0.47
2009	0.00	0.11	0.42	0.78	1.17	1.80	1.80	0.79	0.90	0.74	0.45	0.49	0.41	0.34	0.32
2010	0.00	0.13	0.45	0.98	1.84	1.46	0.83	0.86	0.63	0.31	0.45	0.40	0.19	0.15	0.11
2011	0.00	0.18	0.33	0.62	0.48	0.27	0.24	0.40	0.20	0.23	0.37	0.26	0.18	0.21	0.24
2012	0.00	0.04	0.13	0.26	0.21	0.23	0.20	0.17	0.22	0.21	0.16	0.20	0.12	0.17	0.19
2013	0.00	0.02	0.15	0.18	0.20	0.29	0.23	0.23	0.18	0.14	0.18	0.14	0.15	0.16	0.19
2014	0.00	0.05	0.07	0.14	0.11	0.22	0.15	0.17	0.14	0.07	0.10	0.15	0.25	0.25	0.14
2015	0.00	0.00	0.12	0.00	0.07	0.08	0.08	0.05	0.00						
2016	0.00	0.00	1.09	0.00	0.44	0.14	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.46	0.00
2017	0.00	0.01	0.59	0.10	0.02	0.23	0.64	0.45	0.00	0.00	0.00	0.87	0.00	0.00	0.00
2018	0.00	0.00	0.66	0.08	0.12	0.44	0.10	0.20	0.40	0.14	0.00	0.00	0.25	0.00	0.00
2019	0.00	0.00	0.47	0.06	0.19	0.39	0.40	0.19	0.27	0.34	0.35	0.33	0.30	0.12	0.00
2020	0.00	0.00	0.45	0.06	0.29	0.49	0.45	0.13	0.68	0.07	0.20	0.19	0.59	0.00	0.00
2021	0.00	0.01	0.28	0.15	0.35	0.36	0.18	0.31	0.25	0.34	0.18	0.24	0.00	0.00	0.00

Book/Policy	Fixed Rate 15 Year Streamline Refinance Mortgages														
	by Credit Subsidy Endorsement Cohort														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1993	1.10	6.55	5.65	8.99	9.11	13.12	16.16	10.85	13.53	18.40	25.31	20.29	17.96	19.94	20.02
1994	1.37	3.97	7.05	7.57	10.99	13.69	9.71	12.35	16.30	22.70	19.00	17.12	17.98	17.26	24.91
1995	1.85	9.38	8.28	13.23	17.08	9.91	12.15	18.38	21.98	18.11	14.58	14.08	16.13	13.18	20.33
1996	0.91	4.43	9.75	14.08	9.26	12.58	17.79	26.69	21.80	16.71	16.35	13.54	14.47	17.33	22.51
1997	1.26	9.25	14.45	8.41	11.12	19.16	26.86	21.65	17.61	16.34	13.04	11.60	11.53	15.14	19.58
1998	1.14	7.22	6.36	10.23	16.51	30.18	22.78	16.76	15.51	12.38	12.47	11.43	12.78	15.24	19.61
1999	1.33	4.21	8.43	14.15	26.64	21.04	16.35	14.08	11.23	10.37	9.64	10.28	13.46	15.19	22.48
2000	2.20	12.04	17.72	28.52	25.41	17.82	16.33	12.44	9.85	8.91	8.70	7.40	10.03	16.64	19.26
2001	1.36	13.07	36.66	28.65	21.23	14.10	11.99	10.60	8.21	8.64	8.78	9.47	11.99	20.13	18.69
2002	2.74	24.68	21.49	18.70	13.66	10.84	8.91	8.36	8.09	7.85	8.93	10.84	17.86	18.80	15.85
2003	6.24	12.63	15.35	12.64	10.18	8.36	7.84	7.41	8.18	8.92	10.66	15.75	17.83	16.16	14.54
2004	4.90	11.12	11.03	9.15	7.24	6.33	6.34	6.48	6.97	9.06	14.27	17.51	16.41	16.21	13.33
2005	4.43	8.73	8.56	6.50	5.19	5.63	5.83	6.44	7.97	12.93	16.43	14.61	14.21	14.43	13.19
2006	2.84	7.64	7.10	6.94	5.94	4.96	5.84	8.28	12.21	15.74	14.16	13.16	15.54	14.09	14.34
2007	1.09	8.66	10.98	8.46	5.14	6.75	7.17	10.91	12.99	11.23	12.40	11.74	14.26	13.35	15.79
2008	1.29	8.48	8.06	6.73	10.28	12.63	11.58	11.35	9.98	9.99	10.21	12.56	15.10	15.02	14.87
2009	0.86	5.61	9.97	14.39	16.15	9.60	9.04	7.35	7.45	8.99	10.99	12.21	13.66	15.38	14.79
2010	1.52	8.61	14.78	15.23	10.29	8.41	7.48	6.87	8.40	10.02	11.88	13.19	15.37	16.03	15.01
2011	1.46	33.52	23.76	14.65	9.31	6.79	6.69	8.14	10.18	11.73	12.85	14.55	16.44	18.31	18.00
2012	1.59	13.47	13.71	10.33	6.63	5.75	6.71	8.81	10.05	11.22	12.32	14.72	17.38	18.47	18.21
2013	1.13	7.28	9.21	6.88	5.71	6.14	7.13	8.66	9.53	10.67	12.49	14.74	15.69	16.14	16.40
2014	3.82	12.28	8.20	9.07	8.52	11.69	11.69	10.85	11.46	16.12	17.38	15.48	17.29	15.00	20.53
2015	6.51	15.78	12.77	13.27	13.49	16.77	15.02	12.21	13.46	25.00	21.33	14.34	21.30	15.59	28.88
2016	10.35	27.13	20.38	19.94	13.11	21.52	17.49	11.19	11.08	32.32	22.22	15.28	19.84	8.15	30.70
2017	15.08	38.34	26.27	25.54	16.53	24.08	21.14	15.19	12.26	28.99	23.94	21.69	19.27	9.49	31.81
2018	14.72	37.01	26.29	22.75	16.64	21.49	19.48	16.16	16.37	23.98	27.02	18.16	23.11	15.29	26.38
2019	16.23	36.51	27.04	23.08	17.63	24.09	20.47	17.15	16.59	24.95	20.85	16.03	23.03	14.71	29.54
2020	15.74	40.84	27.83	25.67	18.47	23.54	18.45	15.09	15.63	24.43	20.96	15.04	22.44	13.25	27.36
2021	16.41	40.73	32.93	27.88	18.61	20.03	19.56	16.51	16.39	23.88	23.44	18.95	25.10	18.37	30.68

Cumulative Claim Rates	Fixed Rate 15 Year Streamline Refinance Mortgages														by Credit Subsidy Endorsement Cohort
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1993	0.00	0.04	0.14	0.27	0.42	0.52	0.60	0.66	0.70	0.73	0.74	0.74	0.74	0.75	0.75
1994	0.00	0.06	0.26	0.48	0.70	0.86	0.97	1.02	1.07	1.09	1.10	1.11	1.12	1.12	1.12
1995	0.01	0.15	0.55	1.05	1.39	1.61	1.84	1.97	2.05	2.10	2.10	2.14	2.14	2.14	2.15
1996	0.00	0.05	0.19	0.47	0.72	0.94	1.07	1.12	1.20	1.22	1.23	1.24	1.24	1.24	1.24
1997	0.00	0.15	0.33	0.63	0.86	0.97	1.05	1.10	1.17	1.18	1.19	1.19	1.20	1.20	1.21
1998	0.00	0.02	0.15	0.28	0.45	0.52	0.58	0.63	0.64	0.65	0.66	0.67	0.69	0.70	0.71
1999	0.00	0.03	0.11	0.18	0.30	0.37	0.42	0.45	0.47	0.48	0.50	0.53	0.54	0.55	0.57
2000	0.00	0.08	0.19	0.40	0.54	0.62	0.68	0.76	0.82	0.91	0.97	0.97	0.99	1.05	1.07
2001	0.00	0.05	0.13	0.25	0.48	0.57	0.62	0.65	0.71	0.79	0.84	0.87	0.91	0.94	0.95
2002	0.00	0.04	0.20	0.30	0.39	0.44	0.49	0.54	0.57	0.64	0.67	0.72	0.78	0.84	0.87
2003	0.00	0.05	0.15	0.26	0.31	0.39	0.46	0.60	0.69	0.77	0.91	1.03	1.12	1.17	1.22
2004	0.02	0.09	0.24	0.35	0.45	0.60	0.80	0.98	1.14	1.27	1.47	1.61	1.68	1.73	1.79
2005	0.01	0.11	0.21	0.38	0.67	1.01	1.26	1.53	1.76	2.01	2.19	2.28	2.34	2.42	2.49
2006	0.00	0.04	0.13	0.52	0.99	1.25	1.73	2.07	2.39	2.75	2.86	2.97	3.04	3.08	3.14
2007	0.00	0.13	0.38	1.19	1.46	1.71	2.51	3.66	4.36	4.47	4.80	5.22	5.30	5.37	5.47
2008	0.00	0.09	0.63	1.36	2.33	3.68	5.25	6.34	6.79	7.16	7.57	7.66	7.79	7.86	7.95
2009	0.00	0.11	0.51	1.18	2.02	3.09	4.04	4.41	4.79	5.09	5.25	5.41	5.52	5.60	5.68
2010	0.00	0.14	0.56	1.32	2.52	3.34	3.77	4.17	4.45	4.57	4.73	4.86	4.91	4.95	4.97
2011	0.00	0.19	0.41	0.72	0.93	1.03	1.11	1.24	1.31	1.37	1.46	1.51	1.54	1.57	1.61
2012	0.00	0.04	0.15	0.35	0.49	0.63	0.74	0.84	0.95	1.04	1.10	1.17	1.21	1.25	1.30
2013	0.00	0.02	0.16	0.32	0.47	0.69	0.85	1.00	1.10	1.18	1.26	1.32	1.38	1.42	1.47
2014	0.00	0.05	0.11	0.22	0.30	0.45	0.53	0.62	0.68	0.71	0.75	0.79	0.85	0.89	0.93
2015	0.00	0.00	0.09	0.09	0.13	0.17	0.21	0.22							
2016	0.00	0.00	0.71	0.71	0.87	0.92	0.92	1.13	1.13	1.13	1.13	1.13	1.13	1.16	1.16
2017	0.00	0.00	0.31	0.35	0.35	0.40	0.50	0.56	0.56	0.56	0.56	0.59	0.59	0.59	0.59
2018	0.00	0.00	0.35	0.38	0.42	0.52	0.54	0.57	0.61	0.62	0.62	0.62	0.63	0.63	0.63
2019	0.00	0.00	0.25	0.27	0.32	0.41	0.48	0.50	0.53	0.55	0.57	0.59	0.60	0.60	0.60
2020	0.00	0.00	0.22	0.24	0.32	0.41	0.48	0.49	0.56	0.57	0.58	0.59	0.60	0.60	0.60
2021	0.00	0.01	0.14	0.19	0.27	0.34	0.37	0.40	0.42	0.44	0.45	0.46	0.46	0.46	0.46

Cumulative Prepayment Rates		Fixed Rate 15 Year Streamline Refinance Mortgages										by Credit Subsidy Endorsement Cohort			
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1993	1.12	7.71	13.03	20.99	28.34	37.94	48.14	53.89	60.33	67.85	76.40	81.39	84.95	88.23	92.16
1994	1.40	5.39	12.18	18.96	28.02	38.00	44.12	51.18	59.30	68.87	75.04	79.51	83.42	86.64	93.49
1995	1.88	11.25	18.70	29.60	41.67	47.45	53.85	62.22	70.39	75.67	79.26	82.09	84.92	86.94	92.30
1996	0.93	5.40	14.79	26.96	33.82	42.27	52.64	65.44	73.01	77.57	81.35	83.89	86.30	88.86	92.94
1997	1.28	10.58	23.66	30.17	38.06	50.00	63.54	71.42	76.47	80.33	83.12	85.14	87.18	89.32	93.06
1998	1.16	8.42	14.36	23.31	36.18	55.82	66.02	71.80	76.24	79.31	82.08	84.23	86.41	88.71	92.07
1999	1.36	5.60	13.72	26.16	46.26	57.76	64.79	69.87	73.36	76.29	78.85	81.18	84.01	86.83	92.25
2000	2.24	14.19	29.58	49.97	62.82	69.50	74.49	77.66	79.85	81.92	83.81	85.04	86.57	89.04	92.03
2001	1.38	14.53	46.44	62.00	70.18	74.41	77.49	79.88	81.58	83.21	84.87	86.34	88.04	90.68	92.70
2002	2.80	27.30	43.19	53.99	60.36	64.72	67.93	70.72	73.17	75.49	77.98	80.49	84.33	87.61	90.11
2003	6.37	18.45	31.21	40.06	46.28	50.87	54.85	58.33	61.91	65.64	69.76	74.86	79.66	83.30	86.44
2004	5.09	15.87	25.31	32.29	37.31	41.39	45.22	48.94	52.72	57.75	64.27	70.81	75.90	80.30	83.67
2005	4.61	13.10	20.69	25.95	29.88	33.93	37.89	42.07	46.96	54.28	61.79	67.25	71.83	75.98	79.61
2006	2.90	10.47	16.93	22.80	27.48	31.14	35.31	40.93	48.51	56.78	62.57	67.08	71.81	75.64	79.40
2007	1.10	9.81	19.87	26.68	30.47	35.24	39.97	46.71	53.41	58.42	63.35	67.33	71.57	75.15	79.09
2008	1.31	9.84	17.25	22.89	30.88	39.59	46.40	52.10	56.48	60.37	63.87	67.67	71.73	75.28	78.46
2009	0.88	6.57	16.04	28.33	39.98	45.71	50.51	53.99	57.25	60.88	64.87	68.81	72.70	76.56	80.03
2010	1.57	10.22	23.68	35.46	42.15	46.94	50.79	54.07	57.77	61.80	66.04	70.20	74.45	78.40	82.01
2011	1.50	35.00	50.67	57.98	61.92	64.51	66.91	69.61	72.73	75.96	79.06	82.17	85.18	88.08	90.72
2012	1.64	15.23	27.14	34.82	39.22	42.81	46.76	51.59	56.61	61.65	66.58	71.78	77.05	81.78	85.90
2013	1.16	8.58	17.21	23.02	27.53	32.09	37.08	42.72	48.35	54.10	60.10	66.33	72.01	77.12	81.99
2014	3.91	15.92	22.95	30.09	36.16	43.77	50.48	56.01	61.20	67.68	73.52	77.86	81.95	85.00	89.12
2015	6.62	21.56	31.79	40.98	49.16	57.88	64.31	68.84	73.23	80.35	84.74	87.10	90.01	91.75	94.98
2016	10.49	35.06	48.47	58.76	64.16	71.91	76.78	79.32	81.63	87.71	90.33	91.80	93.34	93.90	96.09
2017	15.26	48.11	61.92	71.72	76.41	82.14	85.91	88.04	89.51	92.72	94.39	95.58	96.39	96.70	97.97
2018	14.92	46.76	60.95	69.88	74.95	80.39	84.21	86.77	88.97	91.69	93.92	95.03	96.14	96.72	97.74
2019	16.46	47.27	61.68	70.55	75.79	81.69	85.45	87.98	89.98	92.54	94.11	95.06	96.17	96.74	97.91
2020	15.94	50.61	64.48	73.64	78.51	83.58	86.60	88.62	90.38	92.79	94.24	95.10	96.16	96.65	97.75
2021	16.64	50.93	67.25	76.43	80.83	84.68	87.68	89.76	91.45	93.51	95.00	95.98	96.95	97.52	98.38

Conditional Claim Rates Adjustable Rate Mortgages by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	0.00	0.16	0.66	1.10	1.62	2.34	2.36	1.92	1.60	0.84	0.61	0.58	0.36	0.26	0.20	0.12	0.18	0.27	0.21	0.17	0.37	0.28	0.63	0.66	0.58	0.79	1.06	0.85	1.02	1.07
1993	0.00	0.15	0.72	1.38	2.65	2.47	2.19	1.79	1.06	0.74	0.75	0.47	0.29	0.27	0.24	0.23	0.33	0.51	0.31	0.40	0.44	0.84	1.03	0.69	0.88	1.11	1.11	1.00	1.39	1.12
1994	0.00	0.17	0.92	2.15	2.75	2.65	1.98	1.10	0.91	0.93	0.69	0.37	0.37	0.23	0.25	0.31	0.51	0.48	0.35	0.67	0.71	1.10	0.90	0.99	1.34	1.24	1.52	1.40	1.48	1.68
1995	0.01	0.34	1.83	3.20	4.09	3.16	2.04	1.84	2.10	1.57	0.99	0.77	0.49	0.67	0.74	1.12	0.86	0.72	1.04	1.41	1.74	1.10	1.37	1.91	1.74	1.73	1.80	1.70	2.03	1.66
1996	0.00	0.33	1.75	3.78	3.96	2.72	2.79	3.18	2.13	1.37	1.09	0.71	1.23	1.17	1.23	1.42	1.24	1.38	1.77	2.25	1.30	1.92	1.82	2.29	2.02	2.39	2.14	2.53	2.24	2.02
1997	0.01	0.42	2.00	3.30	2.91	3.53	3.88	2.56	1.78	1.38	1.26	1.44	1.51	1.64	1.40	1.52	1.46	2.11	2.03	1.58	2.19	2.19	2.30	2.44	2.45	2.35	2.59	2.66	2.17	2.16
1998	0.01	0.79	2.25	2.49	2.98	3.60	2.65	1.92	1.50	1.31	1.64	1.54	2.11	1.46	1.71	1.92	1.80	2.60	2.01	2.64	2.59	2.81	2.71	2.60	2.55	3.09	2.42	2.41	2.74	2.17
1999	0.00	0.23	0.84	1.99	3.18	2.83	1.77	1.56	1.63	1.35	2.66	2.66	2.19	2.82	2.30	2.72	3.10	2.18	2.47	2.94	3.33	2.97	3.21	2.40	2.64	2.62	2.63	3.14	3.36	2.62
2000	0.01	0.51	1.68	3.26	2.99	2.37	2.00	2.15	2.83	3.42	3.03	2.64	2.63	2.96	2.90	3.12	2.28	2.41	3.23	2.56	3.14	3.27	2.96	3.68	2.75	3.24	3.76	2.79	3.26	2.33
2001	0.00	0.33	1.25	1.87	1.47	2.12	2.05	2.87	3.81	3.74	3.54	3.36	3.09	2.30	3.00	2.46	2.69	3.05	3.54	3.32	3.73	2.11	3.17	2.15	2.55	2.52	2.78	1.71	2.12	1.70
2002	0.00	0.23	1.45	1.85	2.20	2.85	4.61	5.26	5.03	4.58	4.31	4.40	3.52	3.99	2.67	3.36	3.71	2.98	3.27	3.45	3.13	3.43	2.79	2.83	3.02	2.80	2.87	2.21	2.33	1.88
2003	0.01	0.54	1.48	2.13	3.56	5.37	5.76	6.17	4.35	4.74	4.36	4.39	4.39	2.89	3.07	4.15	3.91	3.34	3.68	3.61	4.20	3.39	3.08	3.20	3.78	3.80	2.59	3.27	2.53	1.62
2004	0.08	0.64	1.61	3.05	5.54	6.29	5.82	4.70	4.84	5.08	5.13	5.65	3.60	3.87	4.23	3.75	3.89	3.95	3.96	4.09	4.00	4.00	3.45	3.24	3.15	3.15	2.90	2.34	1.89	1.30
2005	0.09	0.86	2.43	5.06	6.43	6.96	4.98	5.12	5.54	7.12	7.14	5.28	5.54	6.32	5.94	5.83	5.76	5.26	5.34	5.32	5.10	5.01	4.29	4.72	4.03	3.91	3.22	3.17	2.55	2.14
2006	0.02	1.12	3.46	6.96	9.02	7.05	7.05	6.06	7.36	8.12	5.35	6.50	7.60	6.54	6.52	5.83	5.27	5.90	6.27	5.50	4.39	4.59	4.42	4.78	4.11	3.48	3.39	3.02	1.94	2.49
2007	0.00	1.02	4.98	9.73	9.01	8.82	8.62	9.75	9.65	8.13	8.04	9.33	7.16	8.60	6.69	6.94	6.69	6.07	5.58	6.12	5.86	6.03	3.80	4.64	3.72	3.16	3.72	2.74	3.21	2.97
2008	0.01	0.57	4.08	6.77	8.25	9.59	13.27	11.27	7.06	7.23	7.31	6.96	5.88	5.73	5.41	5.82	5.29	5.97	5.24	4.80	4.19	5.78	3.26	3.80	3.50	2.98	2.61	2.61	2.41	2.32
2009	0.09	0.93	2.46	3.25	4.78	7.08	7.12	4.51	5.16	5.68	4.83	4.26	4.29	4.42	4.50	4.92	4.44	4.45	3.90	3.94	3.04	3.92	2.25	2.18	3.44	3.24	1.77	2.00	2.34	1.92
2010	0.01	0.17	0.64	1.37	2.70	3.34	2.43	2.99	3.00	2.94	2.76	3.06	2.67	2.80	2.71	3.09	3.01	2.56	2.67	2.78	2.80	2.43	2.44	2.65	2.19	2.12	1.96	2.19	1.78	1.66
2011	0.00	0.19	0.55	1.26	2.18	1.91	2.23	2.60	2.56	2.61	2.77	2.65	2.97	2.46	2.71	3.02	2.63	2.48	2.98	2.79	2.58	2.38	2.51	2.38	2.56	1.99	2.26	2.23	1.85	1.16
2012	0.00	0.13	0.76	1.85	2.12	2.22	2.80	3.03	2.80	3.51	3.08	3.18	2.96	3.04	2.53	2.77	3.13	2.75	2.56	3.05	2.47	2.03	2.37	1.81	2.26	2.71	2.54	2.23	1.72	1.16
2013	0.00	0.11	0.66	1.99	2.68	2.96	3.33	3.06	3.56	2.94	3.29	2.99	4.74	3.34	3.73	3.82	3.86	2.47	2.33	2.37	2.72	2.28	2.94	1.80	3.61	2.75	3.39	2.13	1.52	1.62
2014	0.00	0.27	1.28	1.57	2.70	2.96	3.86	3.42	4.39	6.98	5.70	4.07	8.64	2.66	2.37	3.62	3.15	3.06	3.46	3.05	2.37	6.93	2.25	3.34	5.39	2.30	2.63	1.94	2.20	1.19
2015	0.00	0.09	1.04	3.94	4.55	4.48	5.30	4.02	4.01	4.36	4.95	5.49	7.47	5.78	4.66	4.69	5.07	3.12	7.45	2.58	4.37	3.09	5.46	3.30	8.56	1.36	2.65	3.90	1.38	0.48
2016	0.00	1.25	3.14	5.57	4.75	4.24	5.23	5.21	3.47	3.19	4.54	4.24	5.22	3.10	5.02	4.00	3.92	3.28	3.53	4.15	5.19	6.17	3.79	2.54	4.33	3.64	0.97	1.48	2.10	1.20
2017	0.06	1.09	1.98	4.55	4.91	4.25	6.11	4.43	4.35	3.13	3.09	4.31	2.38	2.93	3.45	3.48	8.10	7.76	8.13	3.66	3.19	5.08	4.53	3.84	3.73	1.25	1.41	0.20	1.10	2.10
2018	0.00	0.65	2.15	2.93	3.58	4.56	4.98	3.53	4.93	4.32	4.05	4.84	5.22	3.94	5.55	4.47	3.44	3.53	4.56	4.21	4.79	3.92	5.15	2.92	2.00	1.16	2.89	2.18	2.68	1.71
2019	0.00	0.81	4.05	3.21	5.35	4.17	6.44	5.15	4.06	4.95	2.94	3.71	6.76	5.46	5.29	6.01	2.88	2.78	2.60	2.55	4.22	3.45	2.73	6.26	1.80	4.10	2.37	0.66	1.44	1.92
2020	0.00	0.59	2.64	3.61	6.88	6.43	8.23	5.61	5.67	5.90	6.90	9.00	6.10	7.47	7.07	4.42	5.99	4.48	5.09	3.29	5.27	6.90	6.70	4.26	1.91	2.29	1.56	1.23	1.80	1.87
2021	0.05	0.90	2.78	5.27	4.61	4.30	6.30	5.29	5.86	4.02	3.15	3.17	6.40	6.17	3.59	5.17	3.94	7.14	5.20	4.01	5.06	5.50	5.74	3.04	1.24	0.77	0.72	1.42	0.57	0.32

Conditional Prepayment Rates Adjustable Rate Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	0.22	3.13	6.82	7.04	13.15	11.88	19.89	20.21	13.12	21.76	24.31	27.29	22.29	17.48	17.20	14.67	10.67	5.78	4.99	4.04	4.06	4.52	2.72	0.62	0.44	0.50	0.43	0.49	0.56	0.40
1993	0.44	3.41	5.30	12.91	10.96	19.65	20.42	12.82	25.07	27.37	30.11	25.39	20.64	17.53	16.50	10.61	6.38	4.95	3.83	3.02	4.16	3.02	1.08	0.69	0.74	0.84	0.92	0.65	0.49	0.32
1994	0.30	2.47	9.91	11.38	21.39	20.47	12.99	25.53	27.07	31.19	26.73	21.87	19.52	16.66	11.25	5.09	4.40	3.71	3.30	3.74	3.03	1.07	0.94	0.82	0.96	1.03	0.76	0.61	0.63	0.43
1995	1.70	10.18	15.65	31.41	23.17	13.53	25.49	26.50	28.59	26.82	23.80	21.54	17.80	10.30	5.19	3.73	2.47	2.56	3.63	3.14	1.45	0.97	0.87	1.04	0.97	0.96	0.74	0.54	0.43	0.59
1996	0.48	6.04	34.07	32.33	15.78	30.27	27.39	27.69	27.02	23.52	21.50	18.90	11.62	5.40	3.91	2.57	2.79	2.98	2.99	1.74	1.20	1.15	1.24	1.11	0.93	1.13	0.94	0.73	0.60	0.29
1997	0.93	18.35	34.36	18.62	36.92	27.39	27.59	25.73	23.21	21.87	19.15	12.32	5.64	3.93	2.57	2.04	3.10	3.50	2.14	1.48	1.40	1.81	1.65	1.36	1.45	0.99	0.72	0.70	0.62	0.55
1998	2.82	20.61	17.25	36.98	28.95	28.05	27.21	25.14	23.44	22.17	13.77	6.98	3.91	3.08	2.40	3.49	3.75	2.55	2.02	1.89	1.70	1.58	1.33	1.67	1.20	0.93	0.92	0.76	0.65	0.41
1999	0.39	3.97	32.47	31.26	30.32	25.77	27.76	27.01	26.84	17.11	7.17	4.41	2.98	2.63	4.53	4.17	2.55	1.84	1.74	1.95	1.87	1.58	1.73	1.29	1.06	1.39	0.83	0.85	0.43	0.53
2000	1.07	33.05	31.03	29.24	24.69	26.83	26.21	26.33	17.04	6.58	4.53	2.26	2.91	4.00	4.61	3.46	2.28	2.04	2.43	2.17	2.08	1.60	1.47	1.42	1.20	1.25	1.02	0.65	0.39	0.43
2001	4.97	20.07	29.69	26.02	31.57	30.79	30.63	18.09	8.39	4.97	3.16	2.95	4.02	5.29	3.97	1.78	1.94	2.35	1.89	2.25	1.94	1.61	1.49	2.02	1.51	0.77	0.71	0.43	0.80	0.36
2002	2.34	27.54	23.94	31.09	31.82	33.12	19.85	7.22	4.71	2.53	2.38	4.85	4.40	3.20	2.06	2.40	3.00	2.43	2.10	1.75	1.86	1.61	1.31	0.89	0.86	1.00	0.53	0.72	0.40	0.29
2003	8.03	22.25	34.00	35.40	34.77	20.62	7.19	4.10	3.14	2.59	4.89	4.34	3.47	2.07	2.93	2.80	2.86	2.39	1.73	2.15	1.97	1.62	1.67	1.03	1.00	0.92	0.93	0.92	0.59	0.45
2004	6.57	29.81	34.49	34.31	19.57	7.29	4.06	2.14	2.38	4.19	4.87	3.67	2.20	2.75	3.20	2.94	2.78	2.73	2.35	1.98	1.60	1.12	1.22	0.89	0.86	0.97	0.69	0.45	0.36	0.43
2005	9.18	22.06	25.69	19.13	7.01	3.59	1.80	2.00	4.56	3.66	2.10	1.52	1.88	2.12	1.99	1.78	1.99	1.68	1.68	1.17	0.96	1.05	1.05	0.88	0.79	0.90	0.43	0.44	0.33	0.40
2006	2.39	12.77	17.85	14.62	5.50	2.24	2.13	5.16	3.31	2.35	1.20	1.35	2.00	1.76	1.82	1.69	1.79	1.14	1.28	1.12	1.17	1.05	1.15	1.11	0.57	0.63	0.30	0.76	0.20	0.30
2007	1.59	11.62	19.31	12.00	4.39	4.43	7.11	2.94	2.09	1.63	1.48	2.51	2.52	1.76	2.48	1.59	1.45	0.66	1.53	0.91	1.62	1.43	0.90	0.89	0.80	0.09	0.58	0.74	0.54	0.43
2008	0.56	25.24	19.78	13.18	11.45	16.21	5.95	3.36	2.11	2.75	3.01	4.28	2.91	2.38	2.70	2.47	2.23	1.76	1.62	1.29	1.14	1.20	1.03	0.90	0.85	0.56	0.04	0.39	0.43	0.20
2009	12.81	19.92	16.86	12.69	18.50	10.05	6.74	4.56	3.72	5.13	5.02	4.99	4.68	4.33	3.38	3.34	2.27	2.09	1.48	2.09	1.04	1.25	1.07	0.89	0.32	0.99	0.23	0.45	0.24	0.83
2010	2.29	8.08	8.76	17.94	15.09	9.57	6.10	6.17	7.16	7.16	6.15	5.54	5.11	4.30	3.81	3.01	2.78	2.16	1.93	1.63	1.61	1.22	0.98	0.92	0.80	0.65	0.54	0.54	0.46	0.35
2011	1.54	10.19	20.50	21.22	14.84	9.18	8.80	10.49	10.24	8.62	7.70	6.17	5.43	4.96	3.55	3.42	2.45	2.47	2.03	1.61	1.49	1.18	0.76	0.82	0.90	0.73	0.70	0.43	0.46	0.29
2012	3.41	19.30	22.42	16.83	10.96	11.28	12.94	11.90	10.36	8.49	7.85	6.28	5.56	5.06	3.78	3.09	2.47	2.26	3.16	1.61	1.21	1.01	0.90	1.06	0.55	0.61	0.50	0.77	0.50	0.30
2013	3.39	14.55	13.60	9.56	11.28	14.39	13.97	12.13	10.53	9.71	7.74	8.49	5.79	3.93	3.96	4.02	3.22	2.48	2.14	0.88	1.48	1.33	0.63	0.98	0.41	0.69	0.60	0.98	0.14	0.07
2014	2.30	9.86	9.37	8.53	12.92	13.97	11.21	9.58	9.23	6.64	6.05	6.35	5.37	3.95	5.48	2.12	1.80	1.59	3.12	3.00	2.43	0.81	1.72	0.26	1.06	0.39	0.60	0.48	0.17	0.46
2015	1.66	5.36	7.97	13.85	14.75	10.05	9.66	11.18	11.59	9.42	5.80	4.87	5.99	4.15	1.84	3.04	1.90	2.13	1.49	1.17	1.90	0.67	1.11	0.53	0.49	0.59	1.50	0.85	0.10	0.03
2016	2.09	7.38	14.45	17.99	12.88	11.01	9.29	8.75	10.07	8.02	3.68	3.75	2.48	2.68	2.94	1.33	1.61	2.43	1.36	1.92	3.24	1.88	0.54	0.43	0.02	0.51	0.67	0.42	0.41	0.01
2017	1.92	12.97	17.52	13.73	14.86	10.68	10.23	7.34	9.04	4.89	5.69	3.73	2.33	4.15	1.62	2.02	2.67	2.18	2.16	2.02	0.62	2.26	1.03	0.54	0.02	0.38	0.50	0.04	0.68	0.10
2018	2.83	14.40	16.87	17.02	14.69	11.87	10.50	8.73	5.65	6.85	6.95	2.93	3.39	4.49	3.24	1.41	1.75	1.76	1.01	2.60	0.94	1.48	0.93	1.47	0.45	0.32	0.63	0.37	0.65	0.34
2019	1.58	12.95	18.39	15.93	16.25	11.80	9.12	6.16	8.51	7.94	5.24	7.04	5.35	1.34	2.70	3.37	2.32	0.61	1.04	1.49	0.40	2.25	1.42	0.52	0.59	0.20	0.35	0.73	0.00	0.06
2020	1.42	13.23	17.33	16.97	13.85	10.62	9.59	7.40	6.44	8.53	6.11	4.61	3.38	2.39	2.36	1.48	0.62	1.83	2.01	1.51	1.48	1.82	0.69	0.61	0.39	1.49	0.33	1.37	0.80	0.79
2021	1.78	10.64	20.02	17.15	13.93	13.34	10.08	9.11	9.02	7.75	5.31	5.78	5.35	2.30	1.86	2.42	3.56	2.17	1.36	0.95	0.92	1.21	0.73	0.33	0.36	0.79	0.00	0.05	0.28	0.44

Cumulative Claim Rates Adjustable Rate Mortgages by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	0.00	0.16	0.81	1.79	3.12	4.76	6.18	7.08	7.66	7.92	8.06	8.16	8.21	8.24	8.25	8.26	8.27	8.29	8.30	8.30	8.32	8.33	8.36	8.38	8.41	8.44	8.48	8.51	8.55	8.60
1993	0.00	0.16	0.85	2.10	4.15	5.81	6.95	7.67	8.03	8.22	8.36	8.41	8.44	8.46	8.48	8.49	8.50	8.52	8.54	8.55	8.57	8.60	8.63	8.66	8.69	8.72	8.76	8.79	8.84	8.88
1994	0.00	0.17	1.07	2.94	5.00	6.50	7.36	7.77	8.02	8.20	8.29	8.33	8.35	8.37	8.38	8.39	8.41	8.43	8.45	8.47	8.50	8.53	8.56	8.59	8.64	8.68	8.72	8.77	8.81	8.87
1995	0.01	0.35	1.96	4.29	6.24	7.33	7.91	8.29	8.61	8.77	8.84	8.88	8.90	8.93	8.95	8.98	9.01	9.03	9.05	9.09	9.13	9.16	9.19	9.23	9.27	9.31	9.34	9.38	9.42	9.46
1996	0.00	0.33	1.97	4.23	5.74	6.57	7.14	7.60	7.81	7.90	7.96	7.99	8.03	8.06	8.10	8.13	8.16	8.19	8.23	8.28	8.31	8.34	8.38	8.42	8.46	8.50	8.54	8.58	8.62	8.66
1997	0.01	0.42	2.03	3.72	4.89	5.73	6.38	6.67	6.81	6.89	6.95	7.01	7.05	7.10	7.14	7.18	7.22	7.27	7.32	7.36	7.40	7.45	7.50	7.54	7.59	7.63	7.68	7.73	7.77	7.81
1998	0.01	0.78	2.50	4.03	5.14	6.05	6.51	6.74	6.87	6.96	7.04	7.11	7.19	7.24	7.30	7.37	7.42	7.50	7.56	7.63	7.70	7.77	7.83	7.89	7.95	8.02	8.07	8.12	8.17	8.23
1999	0.00	0.23	1.04	2.31	3.66	4.46	4.81	5.03	5.20	5.29	5.45	5.59	5.70	5.83	5.93	6.04	6.16	6.24	6.32	6.42	6.53	6.61	6.71	6.77	6.84	6.91	6.97	7.05	7.13	7.20
2000	0.01	0.52	1.62	3.07	3.96	4.47	4.77	5.01	5.23	5.44	5.61	5.75	5.88	6.01	6.14	6.26	6.35	6.44	6.55	6.63	6.73	6.82	6.90	7.00	7.07	7.15	7.24	7.30	7.37	7.43
2001	0.00	0.32	1.27	2.25	2.80	3.34	3.68	4.00	4.34	4.64	4.89	5.11	5.31	5.44	5.60	5.73	5.86	5.99	6.15	6.28	6.43	6.51	6.62	6.69	6.77	6.85	6.94	6.99	7.06	7.12
2002	0.00	0.23	1.26	2.24	3.01	3.67	4.35	4.94	5.43	5.83	6.19	6.52	6.77	7.02	7.18	7.37	7.57	7.71	7.87	8.02	8.15	8.29	8.39	8.50	8.60	8.70	8.79	8.86	8.94	9.00
2003	0.01	0.51	1.57	2.54	3.56	4.50	5.24	5.94	6.38	6.83	7.21	7.55	7.87	8.06	8.25	8.50	8.71	8.88	9.06	9.23	9.41	9.54	9.66	9.78	9.91	10.03	10.12	10.22	10.30	10.36
2004	0.08	0.68	1.73	3.00	4.43	5.65	6.62	7.33	8.01	8.68	9.28	9.88	10.23	10.58	10.94	11.24	11.52	11.79	12.04	12.28	12.50	12.71	12.89	13.04	13.18	13.33	13.45	13.55	13.64	13.71
2005	0.09	0.87	2.57	5.12	7.57	9.86	11.33	12.74	14.15	15.79	17.25	18.23	19.19	20.20	21.07	21.85	22.56	23.16	23.73	24.25	24.72	25.15	25.50	25.86	26.15	26.43	26.65	26.86	27.03	27.20
2006	0.02	1.13	4.05	8.67	13.36	16.49	19.34	21.56	23.97	26.32	27.71	29.29	30.99	32.30	33.51	34.49	35.32	36.17	37.01	37.69	38.20	38.69	39.15	39.61	39.98	40.29	40.58	40.85	41.01	41.28
2007	0.00	1.02	5.33	11.70	16.31	20.21	23.52	26.68	29.40	31.42	33.21	35.10	36.37	37.75	38.70	39.60	40.39	41.06	41.62	42.19	42.71	43.20	43.48	43.80	44.05	44.25	44.49	44.66	44.86	45.08
2008	0.01	0.58	3.61	7.43	11.16	14.63	18.19	20.62	21.92	23.13	24.22	25.16	25.86	26.48	27.02	27.55	27.99	28.45	28.82	29.14	29.39	29.73	29.91	30.10	30.28	30.42	30.54	30.66	30.78	30.91
2009	0.09	0.91	2.62	4.44	6.69	9.24	11.36	12.51	13.71	14.91	15.82	16.54	17.20	17.82	18.39	18.96	19.43	19.87	20.23	20.58	20.83	21.14	21.31	21.47	21.71	21.93	22.06	22.19	22.36	22.54
2010	0.01	0.18	0.76	1.88	3.66	5.46	6.60	7.89	9.06	10.08	10.95	11.82	12.52	13.19	13.79	14.43	15.01	15.48	15.95	16.40	16.85	17.22	17.57	17.95	18.25	18.54	18.80	19.09	19.33	19.60
2011	0.00	0.19	0.68	1.56	2.74	3.60	4.48	5.40	6.19	6.88	7.54	8.10	8.67	9.10	9.54	10.00	10.37	10.71	11.09	11.43	11.73	12.00	12.26	12.51	12.78	12.97	13.19	13.41	13.59	13.72
2012	0.00	0.13	0.73	1.84	2.87	3.80	4.83	5.75	6.48	7.27	7.88	8.44	8.91	9.36	9.69	10.04	10.40	10.71	10.98	11.28	11.51	11.70	11.91	12.06	12.25	12.47	12.68	12.87	13.02	13.14
2013	0.00	0.10	0.65	2.06	3.74	5.33	6.81	7.93	9.03	9.81	10.57	11.19	12.05	12.59	13.15	13.67	14.16	14.46	14.72	14.98	15.26	15.48	15.76	15.93	16.27	16.53	16.83	16.99	17.12	17.30
2014	0.00	0.27	1.41	2.65	4.56	6.31	8.22	9.65	11.24	13.42	14.95	15.92	17.76	18.24	18.64	19.21	19.67	20.10	20.56	20.93	21.20	22.00	22.23	22.57	23.07	23.28	23.52	23.70	23.92	24.04
2015	0.00	0.09	1.07	4.42	7.58	10.09	12.61	14.24	15.61	16.87	18.09	19.31	20.80	21.78	22.49	23.15	23.82	24.20	25.07	25.33	25.77	26.07	26.57	26.86	27.60	27.70	27.92	28.21	28.31	28.36
2016	0.00	1.23	4.05	8.16	10.83	12.79	14.84	16.57	17.56	18.35	19.33	20.17	21.12	21.64	22.43	23.00	23.54	23.96	24.37	24.85	25.42	26.04	26.38	26.62	27.00	27.31	27.39	27.53	27.71	27.81
2017	0.06	1.14	2.81	5.90	8.61	10.49	12.78	14.17	15.36	16.09	16.76	17.60	18.03	18.53	19.07	19.60	20.79	21.78	22.72	23.09	23.40	23.87	24.28	24.61	24.89	24.98	25.09	25.10	25.22	25.40
2018	0.00	0.64	2.42	4.37	6.28	8.27	10.07	11.13	12.45	13.47	14.31	15.21	16.10	16.71	17.49	18.08	18.50	18.92	19.44	19.88	20.35	20.71	21.16	21.41	21.56	21.65	21.88	22.05	22.24	22.40
2019	0.00	0.80	4.25	6.37	9.20	10.93	13.16	14.66	15.70	16.81	17.39	18.04	19.12	19.89	20.57	21.29	21.59	21.87	22.13	22.37	22.76	23.06	23.30	23.79	23.93	24.26	24.42	24.47	24.59	24.74
2020	0.00	0.59	2.84	5.28	8.98	11.72	14.60	16.22	17.63	18.92	20.19	21.68	22.54	23.48	24.29	24.74	25.31	25.71	26.12	26.37	26.76	27.26	27.67	27.92	28.03	28.16	28.25	28.32	28.41	28.55
2021	0.05	0.94	3.35	6.87	9.25	11.05	13.21	14.71	16.15	16.97	17.54	18.07	19.04	19.86	20.29	20.88	21.29	21.97	22.43	22.77	23.17	23.58	23.97	24.16	24.24	24.29	24.33	24.43	24.46	24.49

Cumulative Prepayment Rates Adjustable Rate Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	0.22	3.37	9.97	16.29	27.10	35.43	47.39	56.82	61.58	68.32	74.13	79.04	81.92	83.67	85.08	86.07	86.69	86.98	87.23	87.41	87.59	87.78	87.89	87.91	87.93	87.95	87.97	87.99	88.01	88.03
1993	0.44	3.86	8.97	20.66	29.16	42.33	52.97	58.14	66.76	73.70	79.19	82.38	84.30	85.59	86.59	87.12	87.41	87.61	87.76	87.88	88.03	88.14	88.17	88.20	88.22	88.25	88.28	88.30	88.32	88.33
1994	0.30	2.78	12.42	22.30	38.37	50.01	55.70	65.18	72.54	78.65	82.20	84.30	85.76	86.75	87.30	87.53	87.71	87.86	87.98	88.12	88.23	88.26	88.30	88.32	88.35	88.39	88.41	88.43	88.45	88.47
1995	1.71	11.76	25.56	48.40	59.40	64.07	71.40	76.91	81.17	83.94	85.69	86.88	87.64	88.00	88.16	88.27	88.34	88.41	88.51	88.59	88.62	88.64	88.66	88.69	88.71	88.73	88.75	88.76	88.77	88.78
1996	0.49	6.53	38.39	57.73	63.76	73.03	78.64	82.60	85.27	86.92	88.04	88.80	89.18	89.33	89.43	89.50	89.57	89.64	89.70	89.74	89.76	89.79	89.81	89.83	89.85	89.87	89.89	89.90	89.91	89.92
1997	0.93	19.22	46.91	56.45	71.21	77.78	82.36	85.28	87.16	88.49	89.38	89.84	90.02	90.14	90.21	90.26	90.35	90.43	90.48	90.52	90.55	90.59	90.62	90.65	90.67	90.69	90.70	90.72	90.73	90.74
1998	2.84	22.95	36.16	58.94	69.70	76.80	81.50	84.54	86.60	88.06	88.75	89.05	89.20	89.31	89.40	89.52	89.64	89.71	89.77	89.82	89.87	89.91	89.94	89.98	90.01	90.03	90.04	90.06	90.07	90.08
1999	0.39	4.37	35.48	55.40	68.31	75.59	81.17	84.99	87.68	88.91	89.33	89.56	89.71	89.83	90.03	90.21	90.30	90.37	90.43	90.50	90.55	90.60	90.65	90.69	90.72	90.75	90.77	90.80	90.81	90.82
2000	1.07	33.92	54.34	67.29	74.66	80.44	84.42	87.28	88.60	89.01	89.27	89.38	89.53	89.72	89.92	90.06	90.14	90.22	90.30	90.37	90.43	90.48	90.52	90.56	90.59	90.62	90.65	90.66	90.67	90.68
2001	4.99	24.17	46.72	60.35	72.24	79.97	85.11	87.14	87.89	88.28	88.51	88.71	88.96	89.26	89.48	89.57	89.66	89.77	89.85	89.94	90.02	90.07	90.13	90.20	90.24	90.27	90.29	90.30	90.33	90.34
2002	2.35	29.42	46.38	62.78	73.97	81.64	84.57	85.37	85.83	86.06	86.25	86.63	86.93	87.14	87.26	87.40	87.56	87.68	87.78	87.85	87.93	88.00	88.05	88.08	88.11	88.15	88.17	88.19	88.21	88.22
2003	8.10	28.69	52.92	69.12	79.02	82.63	83.56	84.02	84.34	84.58	85.01	85.35	85.60	85.74	85.93	86.09	86.25	86.37	86.46	86.56	86.64	86.71	86.77	86.81	86.85	86.88	86.91	86.94	86.96	86.98
2004	6.65	34.65	57.06	71.26	76.32	77.73	78.41	78.73	79.07	79.62	80.20	80.59	80.80	81.05	81.32	81.56	81.76	81.95	82.10	82.22	82.31	82.37	82.43	82.48	82.52	82.56	82.59	82.61	82.63	82.65
2005	9.33	29.45	47.46	57.04	59.71	60.89	61.42	61.98	63.15	63.99	64.42	64.70	65.03	65.37	65.66	65.90	66.15	66.35	66.53	66.64	66.74	66.83	66.92	66.99	67.05	67.12	67.15	67.18	67.20	67.23
2006	2.41	14.94	29.98	39.66	42.51	43.50	44.35	46.24	47.32	48.00	48.31	48.64	49.09	49.45	49.78	50.07	50.35	50.52	50.69	50.83	50.98	51.09	51.22	51.33	51.39	51.45	51.48	51.54	51.56	51.60
2007	1.60	13.10	29.79	37.60	39.84	41.80	44.53	45.48	46.06	46.47	46.80	47.31	47.76	48.04	48.40	48.61	48.78	48.85	49.01	49.10	49.25	49.37	49.44	49.50	49.56	49.56	49.60	49.65	49.68	49.71
2008	0.57	25.80	40.42	47.83	53.01	58.86	60.44	61.17	61.55	62.01	62.47	63.04	63.39	63.65	63.92	64.15	64.34	64.48	64.60	64.68	64.76	64.83	64.89	64.94	64.98	65.01	65.02	65.04	65.06	65.07
2009	12.89	30.35	42.00	49.09	57.76	61.36	63.36	64.53	65.39	66.47	67.42	68.27	68.98	69.59	70.03	70.42	70.66	70.88	71.02	71.21	71.30	71.40	71.48	71.55	71.57	71.65	71.66	71.70	71.71	71.77
2010	2.32	10.26	18.18	32.88	42.81	47.97	50.84	53.49	56.29	58.79	60.73	62.32	63.66	64.70	65.56	66.19	66.74	67.15	67.50	67.78	68.04	68.24	68.39	68.53	68.64	68.73	68.81	68.88	68.95	69.00
2011	1.56	11.67	29.89	44.75	52.78	56.90	60.41	64.13	67.28	69.59	71.42	72.73	73.79	74.67	75.26	75.80	76.16	76.50	76.77	76.97	77.15	77.29	77.38	77.47	77.56	77.64	77.71	77.75	77.80	77.84
2012	3.44	22.27	39.82	49.91	55.24	60.00	64.73	68.38	71.08	73.01	74.58	75.70	76.59	77.34	77.86	78.25	78.55	78.81	79.15	79.32	79.44	79.54	79.62	79.72	79.77	79.82	79.86	79.93	79.97	80.00
2013	3.43	17.63	28.92	35.71	42.80	50.56	56.77	61.24	64.51	67.11	68.92	70.69	71.75	72.41	73.02	73.59	74.02	74.32	74.57	74.67	74.83	74.97	75.03	75.12	75.16	75.22	75.27	75.36	75.38	75.39
2014	2.32	12.04	20.32	27.06	36.22	44.57	50.14	54.17	57.56	59.66	61.32	62.84	64.02	64.77	65.73	66.07	66.35	66.58	67.02	67.41	67.71	67.80	67.99	68.02	68.13	68.17	68.22	68.27	68.29	68.35
2015	1.68	6.99	14.46	26.25	36.54	42.21	46.88	51.47	55.50	58.27	59.75	60.86	62.08	62.82	63.12	63.57	63.84	64.12	64.31	64.44	64.65	64.72	64.83	64.88	64.92	64.97	65.09	65.16	65.17	65.17
2016	2.11	9.39	22.39	35.72	43.02	48.14	51.82	54.78	57.72	59.75	60.58	61.36	61.84	62.31	62.80	63.01	63.25	63.59	63.77	64.01	64.40	64.61	64.66	64.70	64.70	64.75	64.82	64.85	64.90	64.90
2017	1.94	14.76	29.59	38.94	47.21	51.97	55.86	58.21	60.77	61.97	63.25	64.02	64.47	65.23	65.50	65.83	66.24	66.54	66.81	67.03	67.09	67.32	67.42	67.47	67.47	67.50	67.55	67.55	67.61	67.62
2018	2.84	16.95	30.94	42.37	50.26	55.47	59.33	62.05	63.61	65.29	66.81	67.39	68.00	68.75	69.24	69.43	69.66	69.88	70.00	70.29	70.39	70.53	70.62	70.73	70.77	70.80	70.86	70.89	70.95	70.98
2019	1.59	14.45	30.14	40.67	49.35	54.30	57.53	59.37	61.64	63.48	64.54	65.86	66.76	66.95	67.33	67.76	68.03	68.10	68.21	68.36	68.40	68.62	68.75	68.79	68.84	68.86	68.89	68.94	68.94	68.95
2020	1.43	14.58	29.39	40.98	48.52	53.10	56.56	58.74	60.38	62.30	63.48	64.26	64.75	65.07	65.36	65.52	65.58	65.76	65.94	66.07	66.19	66.33	66.38	66.42	66.45	66.53	66.55	66.63	66.69	66.73
2021	1.79	12.34	29.83	41.38	48.67	54.38	57.95	60.63	62.91	64.59	65.62	66.64	67.50	67.82	68.06	68.35	68.76	68.99	69.12	69.21	69.28	69.37	69.42	69.45	69.48	69.53	69.53	69.54	69.56	69.60

Conditional Claim Rates Adjustable Rate Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1995	0.00	0.60	2.29	2.59	3.91	3.87	1.25	0.98	1.79	0.46	0.32	1.54	0.79	0.53	0.68	0.49	0.68	0.00	0.00	1.28	0.35	0.92	1.09	1.37	1.03	0.00	2.71	0.29	0.66	1.47
1996	0.01	0.44	2.25	4.06	3.13	1.45	1.69	0.66	1.00	1.17	0.83	0.71	0.54	0.26	1.36	0.40	0.29	0.84	1.85	1.05	0.20	0.64	0.32	1.40	0.64	0.19	0.90	1.14	1.57	0.93
1997	0.01	0.42	2.19	3.78	2.90	2.45	2.20	1.25	0.77	0.36	0.77	1.12	0.97	1.29	0.90	1.31	1.03	1.53	2.00	1.83	0.93	1.58	0.65	0.21	0.42	1.81	2.99	0.77	0.62	0.84
1998	0.01	0.34	1.24	1.40	1.61	1.82	1.71	1.32	0.64	0.00	0.57	0.35	1.12	0.65	1.13	0.20	2.80	2.29	1.42	2.42	1.03	1.08	1.09	0.65	0.95	0.96	2.24	0.82	1.44	1.05
1999	0.00	0.14	0.48	0.93	2.40	1.69	1.26	0.54	0.83	0.56	1.11	0.71	2.19	1.69	3.79	2.10	2.15	1.34	2.67	2.71	1.38	3.39	2.22	2.28	2.85	1.67	1.45	2.53	1.29	1.45
2000	0.00	0.39	1.82	4.22	2.67	2.94	1.99	1.75	2.42	1.24	4.38	2.00	2.35	2.08	3.84	2.83	0.43	1.31	2.26	1.43	1.63	1.80	1.17	0.55	2.17	0.81	1.10	1.14	1.27	1.07
2001	0.03	0.19	1.92	2.90	2.07	1.83	1.79	2.94	5.95	4.52	4.01	1.46	4.16	3.52	5.41	2.89	3.00	1.55	3.13	1.46	3.04	1.39	0.47	2.66	1.94	1.84	0.80	1.27	0.98	1.39
2002	0.01	0.40	1.79	2.10	2.49	2.97	4.86	4.80	5.20	3.60	3.74	3.69	4.20	5.08	2.79	2.83	2.99	2.67	2.80	1.56	2.37	1.99	1.88	2.25	1.56	2.08	1.62	1.20	1.28	0.84
2003	0.02	0.81	2.19	2.84	3.27	5.73	5.45	5.64	4.85	4.55	4.58	4.38	4.54	3.20	2.80	2.72	2.29	2.14	2.54	2.06	1.96	2.04	1.68	2.83	1.73	1.51	1.26	1.55	1.59	0.93
2004	0.13	1.26	2.81	3.65	6.20	6.63	5.89	3.87	4.72	4.42	4.83	4.68	3.02	3.86	3.49	3.07	2.88	2.83	2.23	2.15	2.42	1.86	1.55	1.72	1.49	1.30	1.39	1.50	1.36	0.59
2005	0.26	2.04	4.06	5.40	6.77	5.61	4.70	4.49	4.87	4.67	5.00	3.86	3.63	3.79	3.91	4.26	3.60	2.86	3.82	3.35	2.95	2.76	2.61	3.34	3.17	3.09	2.00	2.18	1.52	0.98
2006	0.00	2.49	6.58	7.25	11.84	3.67	5.12	3.84	8.72	3.86	4.18	4.74	6.57	1.90	4.97	4.55	4.66	5.33	6.51	1.71	3.40	4.10	3.75	1.17	2.84	2.34	4.03	3.49	2.04	0.00
2007	0.00	2.34	4.05	11.85	8.38	1.98	11.94	3.47	11.09	5.48	8.65	12.35	3.82	7.15	5.23	3.35	2.59	5.17	7.22	6.65	6.52	3.21	0.00	1.69	0.00	7.52	0.00	0.00	0.00	0.00
2008	0.00	1.06	6.86	10.02	6.87	13.55	19.54	15.24	8.48	11.93	9.95	10.45	7.15	11.33	7.04	6.48	5.81	5.87	6.53	3.44	5.47	3.67	4.08	0.81	3.84	1.29	4.85	1.57	2.18	1.43
2009	0.04	0.80	3.26	5.75	9.78	12.03	12.19	9.24	9.49	9.47	6.68	6.06	5.40	4.19	3.76	4.43	5.07	3.85	3.83	3.14	3.51	3.22	3.08	1.90	0.86	2.20	1.72	1.19	1.25	0.88
2010	0.12	1.40	3.45	6.11	9.21	8.85	5.61	5.80	6.03	4.90	4.74	4.68	3.55	3.52	3.72	3.76	2.77	2.54	2.34	2.39	2.56	2.33	1.29	1.64	1.72	1.39	1.13	1.24	1.25	0.89
2011	0.03	0.81	2.52	3.74	4.46	3.75	3.84	4.40	4.26	3.85	3.50	3.38	3.74	3.28	2.85	2.38	1.97	2.50	1.70	2.26	1.85	1.94	1.55	2.04	1.14	1.23	1.06	0.71	0.88	0.89
2012	0.06	0.87	1.93	3.41	3.24	3.36	4.11	3.93	3.90	3.82	3.00	3.51	3.41	2.98	2.46	2.62	1.83	1.65	1.83	1.81	0.91	1.36	1.42	1.06	1.55	1.38	1.27	1.43	0.73	0.90
2013	0.11	0.37	2.27	2.64	4.40	4.32	3.76	4.69	3.53	4.47	2.96	3.10	3.22	3.62	2.52	2.46	4.23	2.28	2.15	3.30	2.24	2.17	1.87	3.13	1.27	0.43	1.72	1.10	0.36	0.00
2014	0.03	0.97	2.75	2.46	4.14	4.19	4.50	4.75	4.02	7.73	4.53	2.49	3.28	1.81	2.15	3.53	1.50	1.37	1.97	0.58	2.25	6.16	0.84	0.63	0.91	0.59	2.89	1.08	0.40	1.25
2015	0.00	0.86	3.20	2.02	2.38	3.46	3.35	3.80	10.19	11.52	5.15	5.30	5.97	0.80	2.86	2.63	2.75	0.00	0.00	0.00	0.99	9.70	0.00	4.61	1.22	1.59	0.00	0.00	0.00	0.00
2016	0.00	1.23	7.21	1.83	3.78	3.92	1.38	7.84	15.10	17.49	3.66	6.78	2.31	5.55	2.18	9.31	10.11	1.19	2.53	0.00	4.80	8.58	0.00	1.98	0.00	0.00	0.00	0.00	0.00	0.00
2017	0.02	1.10	4.85	1.25	1.95	2.92	1.10	5.25	10.21	17.92	2.94	8.38	5.06	1.44	1.34	6.36	5.05	0.00	1.08	0.00	0.00	11.00	3.47	3.53	0.00	0.00	4.31	0.00	0.00	0.00
2018	0.01	0.84	2.49	1.62	2.26	3.40	1.02	4.06	7.04	7.21	3.06	4.93	11.67	7.64	2.96	4.43	4.88	0.00	0.00	0.29	4.08	6.13	1.41	1.98	0.93	0.00	1.07	3.69	0.00	0.00
2019	0.02	0.89	2.31	1.38	2.43	2.79	1.85	5.36	8.13	8.92	0.91	5.46	11.29	3.52	2.60	3.40	3.10	0.00	2.08	0.00	1.19	3.85	3.95	0.00	2.93	0.40	0.00	2.84	1.96	1.76
2020	0.02	1.00	2.51	1.66	2.78	3.29	1.61	4.54	7.48	10.09	3.67	3.50	10.77	2.92	1.47	2.12	0.57	0.89	2.64	0.69	4.67	2.93	4.45	0.22	3.06	0.91	0.14	2.18	0.34	0.00
2021	0.06	0.95	2.49	2.29	2.76	2.54	1.55	6.53	5.60	10.03	2.46	3.36	11.49	1.65	1.48	3.10	2.01	1.42	2.29	0.00	3.06	5.57	2.94	3.48	0.31	0.00	0.00	3.75	0.00	0.00

Conditional Prepayment Rates Adjustable Rate Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1995	2.25	18.79	21.06	27.62	18.12	13.60	23.58	27.15	24.42	24.58	20.30	15.95	14.40	9.60	4.73	5.00	2.71	1.45	3.85	1.83	2.48	1.59	0.44	0.00	0.32	1.59	0.50	0.74	0.41	
1996	3.13	22.57	42.06	34.22	15.40	29.29	28.62	30.69	26.99	24.58	21.90	15.82	14.96	6.75	4.59	4.80	2.06	2.74	3.63	2.40	1.69	0.68	1.76	1.23	0.86	0.80	0.22	0.90	0.72	0.57
1997	4.79	40.69	43.35	20.14	35.17	29.37	34.18	31.06	28.59	25.55	22.06	11.76	5.64	3.75	4.21	1.36	2.60	3.25	1.26	1.57	1.16	0.26	0.89	2.64	0.00	0.98	1.05	0.20	0.30	0.88
1998	10.69	42.37	23.05	41.35	35.64	37.40	30.99	30.01	25.68	23.88	15.68	7.69	3.83	3.58	3.85	5.99	3.90	3.40	1.92	2.43	1.50	1.34	3.23	0.94	1.99	1.48	0.60	0.42	1.37	0.23
1999	3.41	10.88	34.24	31.55	33.06	28.58	29.25	28.91	26.08	17.05	9.42	6.94	1.88	2.42	3.12	5.61	3.40	2.15	1.35	2.17	2.22	1.87	2.40	1.51	1.01	0.37	1.12	0.67	0.66	0.00
2000	2.64	23.07	22.00	19.84	23.51	24.87	27.88	27.49	13.98	3.23	3.87	1.69	1.89	3.94	2.98	4.41	1.80	2.67	2.36	2.66	1.90	1.74	0.86	2.04	0.81	1.52	0.41	1.10	0.11	0.86
2001	3.57	33.08	30.59	27.57	33.52	31.98	29.61	16.09	5.83	3.01	1.37	4.02	2.56	3.83	5.57	2.93	2.56	1.99	3.55	2.30	2.05	1.56	1.35	2.25	0.40	1.36	0.33	0.75	0.32	0.60
2002	6.26	35.80	27.91	31.42	32.30	32.02	19.17	7.39	3.53	2.47	2.01	3.91	5.48	4.26	3.55	3.07	3.22	4.16	2.59	2.41	1.27	2.15	1.16	1.21	1.37	0.97	1.14	0.76	0.40	0.53
2003	15.89	29.77	34.13	34.21	34.12	22.28	7.92	4.97	2.42	2.42	4.87	5.36	4.97	4.55	4.02	4.36	3.76	3.51	3.63	2.94	2.27	2.52	2.04	1.16	0.80	1.03	1.13	0.87	0.82	0.28
2004	12.24	31.44	31.21	30.44	18.90	6.59	4.02	2.07	2.34	4.09	5.98	5.56	4.57	4.43	4.48	4.39	4.25	3.68	3.04	2.39	2.89	2.25	1.57	1.16	1.05	0.97	0.54	0.85	0.54	0.28
2005	15.09	25.19	23.60	18.35	5.48	2.90	1.51	2.16	3.95	5.72	5.97	4.37	4.53	4.64	5.09	4.51	4.10	3.59	2.81	2.21	2.45	1.67	1.68	1.29	1.06	0.85	0.75	0.55	0.43	0.57
2006	6.86	16.67	17.55	11.48	4.00	1.03	1.59	3.92	6.76	5.29	2.64	6.43	3.68	7.24	5.51	3.79	3.62	2.30	3.65	1.69	1.90	5.22	0.70	1.77	0.94	0.63	0.72	1.66	0.53	0.00
2007	7.09	19.43	20.91	9.35	3.98	3.46	6.77	4.11	5.45	4.13	4.25	3.04	1.08	3.55	5.11	3.50	2.09	0.00	0.88	6.78	0.00	1.19	0.00	2.22	1.85	0.00	0.00	0.00	3.26	0.00
2008	3.34	29.70	9.24	5.09	5.29	7.56	3.34	3.82	3.17	3.06	2.23	3.54	4.32	5.37	2.12	3.35	2.58	2.91	3.82	3.38	1.46	1.16	4.68	1.21	0.00	0.00	0.00	0.00	0.00	0.42
2009	2.62	11.37	8.94	4.82	7.93	5.20	4.35	4.05	4.22	5.39	4.86	5.96	5.17	6.66	4.92	4.46	2.85	2.90	2.70	3.12	1.42	2.44	1.23	0.95	1.00	1.28	0.18	0.20	0.70	0.15
2010	4.24	11.33	5.43	10.01	8.20	6.32	5.46	6.02	7.61	7.25	7.24	6.72	6.23	5.28	4.39	4.09	3.49	3.07	2.66	1.96	2.13	1.97	1.46	1.06	1.18	0.91	0.84	0.60	0.59	0.42
2011	0.84	8.42	16.83	15.43	11.42	9.49	10.03	11.56	12.55	11.94	10.98	9.59	7.58	7.27	6.20	6.12	4.79	3.94	2.93	2.92	2.12	2.30	1.48	1.88	1.17	0.79	0.87	0.35	0.93	0.43
2012	1.97	17.49	20.46	14.99	12.01	12.12	14.40	13.53	14.16	13.99	10.89	9.42	8.41	7.25	5.63	5.59	4.58	2.91	2.68	2.24	2.15	2.26	2.16	1.02	1.15	0.98	1.20	1.46	0.82	0.63
2013	3.65	18.22	21.36	16.43	14.88	19.45	18.31	17.16	14.85	15.16	11.31	9.95	7.83	8.86	6.00	6.35	5.08	5.38	3.99	2.60	0.64	1.39	2.66	1.70	0.46	1.06	0.87	0.31	0.00	1.54
2014	8.10	21.02	19.34	15.59	19.40	18.82	21.35	16.34	14.89	13.72	8.70	12.32	11.34	7.27	12.67	2.98	5.37	5.57	0.77	2.47	4.83	2.34	4.60	0.00	0.00	0.88	1.38	0.00	0.00	0.00
2015	12.94	23.25	26.31	21.46	18.65	26.37	29.35	14.34	11.46	13.34	12.50	3.40	13.73	2.65	26.47	2.84	0.00	1.37	3.35	3.09	16.27	0.49	14.61	0.00	0.00	1.63	0.00	2.78	0.00	0.00
2016	15.67	32.64	28.87	22.71	24.20	30.42	29.43	16.16	17.38	8.95	12.87	3.74	6.84	7.41	26.18	0.00	0.00	0.00	0.00	1.67	0.00	0.00	15.31	0.00	0.00	0.00	0.00	1.58	0.00	0.00
2017	16.47	39.39	34.85	25.40	26.05	27.35	30.23	18.77	14.17	15.03	8.37	4.79	21.69	5.97	5.65	0.84	0.00	2.38	3.96	0.00	8.06	6.20	18.12	0.00	0.00	0.00	6.06	0.00	0.00	0.00
2018	17.44	39.91	38.18	33.40	28.30	25.35	27.16	19.48	14.08	13.23	10.17	5.91	16.34	2.60	10.58	6.60	0.00	0.48	3.83	1.94	7.15	0.63	9.19	0.00	1.71	1.98	0.95	0.00	0.89	0.00
2019	22.47	42.11	42.65	34.68	26.72	29.34	26.66	20.55	11.96	8.82	5.58	7.66	16.65	4.72	5.81	3.17	0.62	2.91	2.59	1.06	4.55	0.77	5.25	0.00	1.70	0.00	0.66	0.00	0.74	0.00
2020	28.29	50.21	41.92	33.04	27.24	26.29	27.48	18.86	15.09	9.59	5.46	6.71	13.71	2.90	4.76	3.75	0.00	0.00	2.67	1.68	7.22	1.71	4.11	0.00	1.75	1.01	2.10	0.00	0.48	0.12
2021	29.87	49.92	40.91	34.30	28.41	27.11	26.09	19.10	18.09	8.07	10.83	4.83	16.27	4.47	3.09	3.33	1.25	1.22	4.16	3.54	6.68	0.45	4.34	0.82	0.81	0.00	1.19	0.00	0.00	0.11

Cumulative Claim Rates Adjustable Rate Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1995	0	0.589	2.397	3.963	5.61	6.878	7.216	7.414	7.676	7.726	7.752	7.849	7.891	7.914	7.941	7.959	7.983	7.983	7.983	8.02	8.04	8.07	8.10	8.14	8.17	8.17	8.25	8.26	8.28	8.33
1996	0.01	0.44	2.12	3.81	4.61	4.91	5.15	5.22	5.29	5.34	5.37	5.39	5.41	5.41	5.44	5.44	5.45	5.46	5.49	5.51	5.51	5.52	5.52	5.54	5.55	5.55	5.56	5.58	5.60	5.61
1997	0.01	0.41	1.64	2.80	3.47	3.82	4.03	4.11	4.14	4.15	4.17	4.19	4.20	4.22	4.23	4.25	4.26	4.28	4.30	4.32	4.33	4.35	4.35	4.35	4.36	4.38	4.40	4.41	4.42	4.43
1998	0.01	0.31	0.95	1.49	1.84	2.10	2.24	2.31	2.34	2.34	2.35	2.36	2.37	2.38	2.40	2.40	2.44	2.47	2.49	2.52	2.53	2.54	2.55	2.56	2.56	2.57	2.60	2.60	2.62	2.63
1999	0.00	0.14	0.55	1.07	1.98	2.40	2.61	2.67	2.74	2.78	2.83	2.86	2.95	3.02	3.16	3.24	3.31	3.35	3.43	3.50	3.54	3.63	3.69	3.74	3.80	3.84	3.87	3.92	3.95	3.99
2000	0.00	0.38	1.74	4.15	5.31	6.24	6.70	6.98	7.25	7.36	7.76	7.92	8.11	8.27	8.55	8.74	8.77	8.84	8.98	9.05	9.14	9.23	9.29	9.32	9.42	9.46	9.50	9.56	9.63	9.71
2001	0.03	0.22	1.46	2.72	3.35	3.70	3.93	4.19	4.61	4.89	5.12	5.20	5.42	5.59	5.83	5.94	6.05	6.11	6.22	6.26	6.35	6.39	6.41	6.48	6.54	6.58	6.60	6.64	6.66	6.70
2002	0.01	0.38	1.45	2.33	3.03	3.56	4.13	4.56	4.97	5.23	5.48	5.71	5.96	6.23	6.36	6.49	6.61	6.72	6.82	6.87	6.95	7.02	7.08	7.14	7.19	7.25	7.30	7.33	7.37	7.39
2003	0.02	0.70	1.98	3.03	3.79	4.63	5.20	5.71	6.10	6.44	6.76	7.04	7.30	7.46	7.59	7.71	7.81	7.89	7.98	8.05	8.11	8.18	8.23	8.31	8.36	8.40	8.43	8.48	8.52	8.55
2004	0.13	1.24	2.90	4.31	5.89	7.15	8.13	8.71	9.37	9.95	10.53	11.03	11.32	11.66	11.94	12.17	12.36	12.54	12.67	12.80	12.93	13.02	13.10	13.18	13.25	13.31	13.37	13.44	13.50	13.54
2005	0.26	2.00	4.50	6.90	9.20	10.87	12.15	13.30	14.46	15.48	16.46	17.13	17.70	18.26	18.77	19.29	19.69	19.98	20.34	20.63	20.88	21.10	21.30	21.54	21.76	21.97	22.10	22.23	22.33	22.41
2006	0.00	2.34	7.30	11.46	16.98	18.41	20.33	21.66	24.47	25.51	26.54	27.63	28.96	29.31	30.13	30.81	31.44	32.10	32.84	33.00	33.34	33.74	34.06	34.15	34.40	34.58	34.92	35.12	35.28	35.28
2007	0.00	2.20	5.16	11.65	15.28	16.03	20.29	21.29	24.25	25.46	27.20	29.35	29.92	30.91	31.57	31.94	32.21	32.74	33.42	33.98	34.48	34.69	34.69	34.82	34.82	35.32	35.32	35.32	35.32	35.32
2008	0.00	1.03	5.65	11.32	14.61	20.32	26.79	30.66	32.40	34.56	36.08	37.49	38.32	39.48	40.08	40.58	40.98	41.35	41.72	41.90	42.15	42.31	42.51	42.54	42.68	42.73	42.89	42.94	43.03	43.07
2009	0.04	0.83	3.64	7.99	14.60	21.29	26.87	30.40	33.54	36.23	37.85	39.15	40.16	40.86	41.42	42.02	42.65	43.09	43.49	43.80	44.13	44.41	44.67	44.82	44.89	45.06	45.20	45.29	45.39	45.47
2010	0.12	1.47	4.38	9.06	14.99	19.67	22.18	24.49	26.60	28.08	29.34	30.43	31.16	31.81	32.44	33.03	33.42	33.76	34.05	34.34	34.64	34.89	35.03	35.19	35.37	35.50	35.61	35.74	35.86	35.97
2011	0.04	0.84	3.13	5.87	8.49	10.34	11.99	13.61	14.92	15.91	16.66	17.28	17.88	18.34	18.70	18.98	19.18	19.43	19.58	19.77	19.92	20.08	20.20	20.34	20.43	20.51	20.59	20.64	20.70	20.78
2012	0.06	0.92	2.48	4.61	6.25	7.70	9.19	10.34	11.29	12.05	12.53	13.02	13.44	13.75	13.99	14.22	14.37	14.49	14.62	14.75	14.80	14.89	14.98	15.04	15.13	15.21	15.28	15.36	15.40	15.47
2013	0.11	0.47	2.26	3.85	5.98	7.66	8.78	9.86	10.49	11.15	11.49	11.81	12.09	12.37	12.54	12.69	12.93	13.04	13.14	13.29	13.38	13.47	13.54	13.66	13.70	13.72	13.77	13.82	13.83	13.83
2014	0.03	0.93	2.91	4.30	6.19	7.65	8.85	9.80	10.42	11.39	11.84	12.05	12.30	12.40	12.53	12.70	12.77	12.82	12.90	12.92	13.00	13.22	13.24	13.26	13.29	13.30	13.38	13.42	13.43	13.46
2015	0.00	0.75	2.86	3.81	4.65	5.61	6.28	6.78	7.88	8.84	9.17	9.45	9.73	9.76	9.86	9.92	9.98	9.98	9.98	9.98	10.01	10.19	10.19	10.25	10.26	10.28	10.28	10.28	10.28	10.28
2016	0.00	1.04	5.06	5.71	6.72	7.47	7.65	8.34	9.32	10.10	10.22	10.41	10.47	10.59	10.63	10.75	10.86	10.88	10.90	10.90	10.96	11.03	11.03	11.05						
2017	0.02	0.94	3.34	3.71	4.14	4.60	4.72	5.11	5.69	6.46	6.54	6.75	6.86	6.89	6.91	6.99	7.05	7.05	7.07	7.07	7.07	7.18	7.20	7.23	7.23	7.23	7.25	7.25	7.25	7.25
2018	0.01	0.70	1.91	2.38	2.81	3.25	3.34	3.61	3.97	4.25	4.34	4.48	4.76	4.88	4.92	4.98	5.04	5.04	5.04	5.04	5.07	5.13	5.14	5.15	5.16	5.17	5.19	5.19	5.19	5.19
2019	0.02	0.71	1.72	2.06	2.43	2.74	2.87	3.15	3.46	3.74	3.76	3.89	4.12	4.17	4.21	4.24	4.28	4.28	4.30	4.30	4.31	4.35	4.38	4.38	4.40	4.40	4.40	4.42	4.44	4.45
2020	0.02	0.74	1.61	1.93	2.28	2.57	2.67	2.86	3.12	3.37	3.45	3.51	3.69	3.72	3.74	3.76	3.77	3.78	3.80	3.81	3.85	3.88	3.91	3.91	3.93	3.94	3.94	3.95	3.96	3.96
2021	0.06	0.73	1.59	2.03	2.37	2.58	2.67	2.95	3.12	3.36	3.41	3.47	3.64	3.66	3.67	3.70	3.72	3.73	3.75	3.75	3.78	3.82	3.83	3.85	3.85	3.85	3.85	3.88	3.88	3.88

Cumulative Prepayment Rates Adjustable Rate Streamline Refinance Mortgages by Credit Subsidy Endorsement Cohort

Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1995	2.25	20.68	37.30	53.99	61.64	66.11	72.51	78.04	81.62	84.28	85.93	86.94	87.69	88.13	88.32	88.53	88.63	88.68	88.81	88.87	88.95	89.00	89.01	89.01	89.01	89.02	89.07	89.08	89.11	89.12
1996	3.14	25.10	56.52	70.72	74.66	80.77	84.89	87.97	89.82	91.04	91.84	92.28	92.63	92.77	92.86	92.94	92.97	93.02	93.07	93.11	93.13	93.14	93.17	93.19	93.20	93.21	93.21	93.22	93.23	93.24
1997	4.82	43.72	67.99	74.13	82.27	86.48	89.82	91.74	92.94	93.69	94.17	94.37	94.45	94.50	94.56	94.57	94.60	94.64	94.66	94.67	94.69	94.69	94.70	94.72	94.72	94.73	94.74	94.74	94.75	94.75
1998	10.75	48.70	60.50	76.50	84.38	89.56	92.16	93.86	94.84	95.53	95.86	96.00	96.07	96.12	96.19	96.27	96.33	96.37	96.39	96.42	96.44	96.45	96.48	96.49	96.51	96.53	96.54	96.55	96.56	
1999	3.43	13.99	43.54	61.25	73.79	80.76	85.73	89.12	91.27	92.30	92.77	93.08	93.16	93.25	93.38	93.57	93.68	93.75	93.79	93.85	93.91	93.96	94.02	94.05	94.08	94.09	94.11	94.13	94.14	94.14
2000	2.65	25.21	41.63	52.93	63.09	71.01	77.39	81.79	83.37	83.68	84.03	84.17	84.32	84.62	84.84	85.14	85.25	85.41	85.55	85.70	85.80	85.89	85.94	86.03	86.07	86.14	86.16	86.21	86.22	86.25
2001	3.58	35.61	55.35	67.34	77.45	83.62	87.39	88.79	89.20	89.39	89.47	89.69	89.82	90.01	90.26	90.38	90.47	90.54	90.66	90.73	90.80	90.84	90.88	90.94	90.95	90.99	91.00	91.02	91.03	91.04
2002	6.30	40.04	56.78	69.99	78.98	84.77	87.02	87.68	87.95	88.13	88.27	88.52	88.84	89.07	89.24	89.37	89.51	89.67	89.77	89.85	89.90	89.97	90.00	90.04	90.08	90.11	90.14	90.16	90.17	90.19
2003	16.00	41.16	61.13	73.82	81.75	84.98	85.81	86.26	86.46	86.64	86.99	87.33	87.61	87.85	88.04	88.24	88.39	88.52	88.66	88.75	88.83	88.91	88.97	89.00	89.02	89.05	89.08	89.10	89.13	89.13
2004	12.42	40.10	58.50	70.31	75.12	76.38	77.05	77.36	77.69	78.23	78.95	79.54	79.98	80.37	80.74	81.06	81.36	81.59	81.77	81.91	82.07	82.18	82.26	82.32	82.37	82.41	82.44	82.48	82.51	82.52
2005	15.31	36.70	51.24	59.39	61.25	62.11	62.52	63.08	64.02	65.27	66.44	67.19	67.91	68.59	69.27	69.82	70.27	70.64	70.91	71.11	71.31	71.45	71.58	71.68	71.75	71.81	71.86	71.90	71.93	71.98
2006	6.91	22.49	35.73	42.29	44.14	44.55	45.15	46.51	48.69	50.13	50.78	52.26	53.01	54.33	55.25	55.81	56.31	56.60	57.01	57.19	57.38	57.89	57.95	58.10	58.18	58.24	58.30	58.44	58.49	58.49
2007	7.14	25.30	40.54	45.64	47.36	48.67	51.08	52.28	53.73	54.65	55.51	56.05	56.21	56.70	57.36	57.74	57.96	57.96	58.05	58.65	58.65	58.75	58.75	58.92	59.06	59.06	59.06	59.06	59.25	59.25
2008	3.36	32.20	38.39	41.25	43.79	46.96	48.07	49.04	49.69	50.24	50.59	51.07	51.57	52.12	52.30	52.55	52.74	52.93	53.15	53.32	53.39	53.44	53.64	53.69	53.69	53.69	53.69	53.69	53.72	53.72
2009	2.63	13.78	21.44	25.09	30.44	33.33	35.33	36.87	38.27	39.80	40.98	42.26	43.23	44.36	45.10	45.71	46.06	46.40	46.69	47.01	47.14	47.36	47.47	47.55	47.63	47.73	47.75	47.76	47.84	47.85
2010	4.28	15.16	19.73	27.39	32.64	35.98	38.43	40.82	43.48	45.67	47.59	49.15	50.44	51.42	52.17	52.81	53.31	53.73	54.07	54.31	54.56	54.78	54.94	55.05	55.17	55.27	55.35	55.41	55.47	55.51
2011	0.85	9.26	24.51	35.76	42.49	47.19	51.49	55.75	59.63	62.70	65.07	66.84	68.06	69.10	69.89	70.60	71.11	71.51	71.78	72.04	72.22	72.41	72.53	72.67	72.76	72.82	72.88	72.90	72.98	73.01
2012	1.99	19.29	35.74	45.08	51.18	56.38	61.60	65.58	69.02	71.80	73.58	74.91	75.93	76.71	77.26	77.76	78.14	78.36	78.56	78.71	78.86	79.01	79.15	79.21	79.28	79.34	79.41	79.50	79.54	79.58
2013	3.68	21.40	38.22	48.10	55.31	62.90	68.34	72.29	74.97	77.19	78.53	79.54	80.22	80.91	81.32	81.72	82.01	82.29	82.49	82.60	82.63	82.68	82.79	82.86	82.87	82.91	82.95	82.96	82.96	83.01
2014	8.15	27.61	41.52	50.24	59.13	65.70	71.43	74.68	77.02	78.75	79.62	80.68	81.52	81.99	82.71	82.85	83.09	83.33	83.36	83.46	83.64	83.72	83.87	83.87	83.87	83.90	83.93	83.93	83.93	83.93
2015	13.01	33.38	50.82	60.84	67.48	74.89	80.66	82.56	83.80	84.91	85.71	85.89	86.53	86.63	87.61	87.69	87.69	87.72	87.80	87.88	88.24	88.25	88.49	88.49	88.49	88.51	88.51	88.55	88.55	88.55
2016	15.73	43.36	59.48	67.60	74.12	79.98	83.70	85.11	86.27	86.67	87.10	87.20	87.37	87.54	88.04	88.04	88.04	88.04	88.04	88.04	88.06	88.06	88.06	88.20	88.20	88.20	88.20	88.20	88.22	88.22
2017	16.53	49.52	66.89	74.52	80.22	84.54	87.85	89.25	90.06	90.71	90.96	91.08	91.56	91.66	91.75	91.76	91.76	91.79	91.83	91.83	91.93	91.99	92.15	92.15	92.15	92.15	92.19	92.19	92.19	92.19
2018	17.49	50.54	69.25	78.95	84.27	87.58	90.10	91.39	92.11	92.64	92.96	93.13	93.54	93.59	93.75	93.84	93.84	93.85	93.90	93.92	94.00	94.01	94.09	94.09	94.11	94.12	94.13	94.13	94.14	94.14
2019	22.53	55.25	74.12	82.55	86.69	89.92	91.90	92.99	93.46	93.74	93.88	94.07	94.42	94.50	94.58	94.62	94.62	94.66	94.69	94.70	94.75	94.76	94.81	94.81	94.82	94.82	94.83	94.83	94.83	94.83
2020	28.35	64.40	79.09	85.51	88.96	91.29	92.99	93.83	94.34	94.59	94.70	94.83	95.07	95.11	95.16	95.20	95.20	95.20	95.23	95.25	95.33	95.34	95.37	95.37	95.39	95.40	95.41	95.41	95.41	95.42
2021	29.94	64.96	79.06	85.74	89.25	91.54	93.09	93.92	94.49	94.69	94.91	94.99	95.25	95.30	95.33	95.37	95.38	95.39	95.43	95.46	95.52	95.52	95.55	95.56	95.56	95.56	95.57	95.57	95.57	95.57

Loss Rates	All Mortgages by Credit Subsidy Endorsement Cohort																													
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	46.96	48.27	47.83	49.41	51.08	50.85	50.13	49.99	52.00	51.48	53.04	53.68	60.35	71.61	68.70	67.04	66.55	60.66	82.76	56.68	72.13	60.92	133.63	151.31	165.93	208.87	208.44	182.85	341.41	849.25
1985	45.41	48.18	50.00	50.04	49.12	48.65	49.10	48.19	47.63	49.06	50.29	51.92	58.21	57.63	68.86	55.38	57.99	69.44	59.84	68.12	63.86	103.75	105.35	126.40	140.10	194.05	98.55	198.38	166.80	94.89
1986	45.13	50.31	49.70	47.70	46.18	44.77	44.37	42.40	41.52	41.41	41.55	42.36	42.60	43.77	41.70	43.84	48.41	48.66	49.29	63.34	63.60	73.55	119.12	102.53	93.31	111.69	136.58	173.90	100.21	96.99
1987	46.50	47.90	45.84	44.66	44.58	43.56	41.75	40.56	40.06	40.40	41.44	41.35	43.95	42.27	42.04	47.09	49.19	48.86	57.72	71.11	90.38	99.46	104.75	109.96	116.06	137.31	106.56	101.87	92.00	113.60
1988	43.15	43.80	43.89	43.50	43.97	43.70	44.13	45.27	45.12	45.59	47.11	48.59	47.91	48.48	50.17	46.79	53.92	62.20	66.50	95.63	109.67	110.23	110.80	106.40	119.40	126.92	117.81	94.72	108.46	113.02
1989	50.58	45.53	42.98	44.43	44.99	45.66	47.28	47.73	47.98	49.20	50.84	49.03	47.34	46.89	49.04	53.91	61.48	77.74	101.75	128.56	109.25	109.19	115.10	121.18	123.00	108.36	98.97	106.85	113.64	121.17
1990	43.04	43.73	43.20	44.65	47.03	48.67	50.46	51.19	51.72	51.91	50.46	48.97	52.51	52.81	53.34	57.93	71.24	95.43	116.78	99.04	108.06	115.65	116.13	117.29	95.37	99.03	108.96	107.91	111.45	118.27
1991	44.94	41.60	42.57	45.48	48.20	49.56	52.26	52.20	51.68	47.00	47.82	44.08	45.18	48.01	60.98	78.53	93.77	116.49	103.62	96.12	102.42	106.40	106.27	92.30	92.69	103.05	105.15	110.75	113.19	113.85
1992	43.49	41.08	41.51	43.26	45.06	47.79	47.87	47.66	44.00	40.05	36.83	33.48	43.23	47.84	61.97	81.88	100.02	87.63	87.98	91.05	90.62	104.08	91.72	82.31	98.67	103.31	105.75	110.75	111.56	117.03
1993	35.30	36.95	39.85	40.61	44.30	44.12	41.94	38.69	33.90	31.75	33.64	38.99	43.65	59.06	72.19	87.67	85.42	75.79	85.11	83.96	85.31	85.43	76.24	93.89	100.94	105.72	107.33	111.13	114.03	116.83
1994	29.88	37.24	39.72	41.73	42.12	40.01	36.68	31.77	30.72	32.25	34.85	46.63	53.25	69.73	90.86	74.40	77.02	80.72	88.61	94.12	81.27	76.60	89.80	98.19	101.99	105.32	108.50	110.57	112.99	117.16
1995	37.60	37.80	39.74	40.64	40.54	39.24	35.21	34.14	36.86	37.42	43.15	50.07	78.99	83.74	81.21	78.82	80.09	86.73	90.85	84.21	77.96	91.11	98.30	100.20	103.18	106.00	109.98	114.61	115.46	122.08
1996	31.44	38.14	38.14	37.51	36.07	33.68	31.85	34.09	35.45	40.99	52.54	65.98	79.63	84.43	75.80	83.73	85.07	81.61	77.44	74.64	84.65	93.92	99.02	99.66	102.77	106.10	110.28	111.39	117.67	118.52
1997	25.75	36.87	35.48	34.53	32.78	32.18	33.08	36.94	40.43	49.64	65.79	81.32	81.12	80.09	81.19	87.07	86.56	76.89	73.22	82.99	90.26	94.51	98.47	100.58	102.99	106.67	111.70	115.57	120.59	122.58
1998	27.92	35.11	31.66	30.43	30.37	31.06	33.36	37.18	46.94	63.86	76.19	78.49	71.91	76.46	88.65	81.69	71.19	70.62	78.55	86.74	91.52	93.08	97.26	99.73	101.85	105.27	110.47	116.06	116.84	120.60
1999	28.05	31.18	29.65	29.25	29.95	32.73	36.78	43.96	60.81	72.73	74.10	69.13	76.12	82.52	76.93	70.64	68.70	75.95	83.29	87.59	90.26	93.01	95.78	99.14	102.60	106.19	109.19	113.50	115.17	120.26
2000	25.78	30.30	30.00	33.36	35.61	39.30	47.74	60.40	76.30	78.10	75.32	80.84	88.45	82.24	73.00	70.46	75.20	82.92	86.80	90.40	91.69	95.57	96.99	100.89	104.92	109.11	111.62	114.26	119.43	123.73
2001	28.20	29.72	33.09	36.01	38.61	45.54	58.57	70.78	73.75	71.17	76.92	82.70	88.50	69.60	68.85	73.21	79.77	84.87	86.51	89.86	91.83	95.93	98.53	101.02	106.18	109.20	112.81	115.50	117.71	122.54
2002	24.88	31.48	35.29	37.64	42.87	53.45	64.78	68.49	66.86	69.70	78.87	72.84	67.11	65.99	70.47	76.32	80.13	82.04	84.27	86.43	89.42	92.84	96.58	101.61	105.06	107.87	110.09	114.12	117.68	122.95
2003	29.42	35.12	35.35	40.54	50.16	60.40	63.94	62.25	65.11	72.91	68.39	63.90	63.13	63.34	73.13	76.87	78.21	80.40	82.33	84.66	89.02	92.38	95.84	101.09	103.61	107.96	109.98	113.89	116.73	120.61
2004	31.50	33.17	38.54	48.16	57.74	62.13	60.05	64.69	70.96	66.59	61.23	61.87	65.89	71.74	74.87	75.86	77.63	79.94	81.77	85.27	89.16	92.88	96.37	99.78	102.43	107.58	109.77	114.14	118.35	121.19
2005	32.84	38.05	47.71	58.51	62.65	61.30	65.23	71.93	68.65	61.50	61.41	66.13	71.72	74.97	75.47	76.43	77.43	78.48	81.15	84.02	87.93	90.73	94.49	97.76	100.90	105.02	108.93	111.33	115.23	118.01
2006	38.19	44.30	60.31	62.08	61.60	66.13	73.02	71.45	64.13	62.90	67.89	75.07	77.77	78.84	80.25	80.64	81.77	82.73	85.60	88.17	91.01	92.27	95.73	101.18	103.47	107.56	110.10	114.54	116.78	119.99
2007	33.23	52.66	60.14	60.05	65.02	74.00	72.16	65.14	62.14	66.43	73.21	77.52	79.74	80.97	81.98	82.54	83.50	85.95	88.42	90.04	92.19	96.16	99.50	100.28	104.84	110.40	113.49	118.07	119.73	121.19
2008	41.84	53.43	52.81	58.37	65.17	64.32	59.38	57.31	61.28	66.36	71.11	73.88	75.80	77.67	79.32	80.27	82.06	84.46	86.86	89.94	94.13	96.62	100.51	103.41	107.97	111.32	112.05	116.55	120.58	123.81
2009	40.67	43.99	49.91	54.30	52.63	51.23	51.86	54.76	58.56	60.59	63.14	65.98	68.28	70.16	72.70	74.30	77.49	79.92	83.35	86.40	89.41	92.53	96.41	100.48	102.55	105.72	110.63	112.68	115.42	121.15
2010	35.24	43.82	45.29	43.72	42.87	44.67	46.37	49.95	51.11	52.22	55.34	58.61	61.20	64.56	67.15	69.92	71.94	75.08	78.73	81.66	84.96	88.80	93.16	94.37	98.45	102.42	106.69	109.12	112.07	114.88
2011	35.48	39.13	37.63	37.01	38.57	40.12	43.99	45.90	45.99	47.96	51.82	55.80	59.96	63.34	66.07	68.99	72.58	75.28	78.44	81.66	85.39	88.70	93.92	94.31	98.05	102.28	105.47	108.10	114.40	115.07
2012	36.92	34.22	32.07	33.96	35.69	39.51	41.27	41.53	42.35	44.78	48.98	53.25	57.43	61.11	63.85	68.02	70.51	73.00	77.77	80.65	85.39	87.96	90.63	94.52	97.30	100.81	104.31	107.37	111.38	113.72
2013	33.32	30.27	31.01	32.70	37.17	38.56	39.17	39.42	40.53	43.37	47.31	52.37	55.93	59.14	63.36	66.24	69.56	73.15	77.28	80.52	83.63	86.84	89.85	93.02	97.11	100.21	103.02	106.59	110.99	113.64
2014	31.39	26.99	29.72	34.18	36.39	37.09	38.41	38.84	40.14	41.66	46.79	50.62	54.10	58.36	62.09	65.30	68.43	72.77	78.56	79.41	83.50	84.56	89.33	94.81	94.44	97.40	102.57	102.37	106.81	110.49
2015	27.44	29.28	33.21	35.94	37.52	38.72	39.82	40.92	41.63	45.05	48.79	52.98	57.17	62.32	65.95	68.67	71.17	75.67	78.49	82.98	84.83	88.82	90.87	95.88	97.10	103.76	104.63	105.01	107.17	110.36
2016	28.97	31.48	34.14	36.39	38.16	39.68	41.01	42.73	43.74	47.02	51.08	56.66	62.42	64.95	68.66	71.64	76.67	77.83	81.19	84.14	85.83	88.60	93.82	95.97	98.13	101.50	102.32	102.35	105.22	113.03
2017	28.96	31.45	33.34	35.06	37.16	38.46	39.56	41.36	43.53	46.60	51.48	58.23	61.85	66.14	70.14	74.07	76.08	78.58	80.83	84.34	86.82	92.46	95.16	98.68	102.71	104.68	105.65	107.42	112.72	
2018	30.48	30.49	32.33	34.36	36.03	37.81	39.69	41.54	43.19	46.61	52.90	58.89	63.37	67.66	73.60	75.91	78.72	80.14	81.67	85.59	89.91	93.03	94.34	96.59	98.60	101.12	103.31	105.82	108.93	107.12
2019	28.04	30.36	31.80	34.07	35.80	37.67	40.34	41.77	44.74	48.70	53.94	59.63	64.31	69.88	72.39	76.74	77.96	81.56	83.47	85.56	89.55	92.35	94.14	94.09	99.15	101.63	101.72	105.80	107.38	112.11
2020	27.30	29.54	31.64	33.92	36.22	38.80	40.66	42.75	46.09	50.14	56.22	61.80	68.09	71.80	76.42	78.76	79.94	82.76	86.64	88.87	91.08	94.45	94.38	97.24	99.27	102.40	102.15	103.43	106.52	109.52
2021	27.91	29.43	31.37	34.56	36.76	38.26	41.22	43.92	46.71	51.42	56.40	63.52	67.50	72.92	76.81	78.50	80.04	85.02	86.44	88.97	92.51	93.83	9							

Loss Rates	Fixed Rate 30 Year Mortgages by Credit Subsidy Endorsement Cohort																													
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1984	47.19	48.32	47.89	49.32	50.85	50.82	50.02	49.80	51.96	51.39	52.81	53.50	59.80	71.50	68.22	66.46	66.55	60.66	82.76	56.68	72.13	60.92	133.63	151.31	165.93	208.87	208.44	182.85	341.41	849.25
1985	45.36	48.24	49.94	49.99	49.07	48.55	48.92	48.00	47.39	48.78	49.98	51.73	57.63	56.97	63.61	54.71	57.97	69.79	59.84	68.12	61.84	104.51	105.35	126.40	140.10	194.05	98.55	198.38	166.80	94.89
1986	45.09	50.46	49.72	47.61	46.14	44.69	44.30	42.37	41.50	41.22	41.44	42.18	42.60	43.76	41.37	43.95	48.46	48.79	49.11	65.29	64.88	73.55	119.12	102.31	95.35	112.14	138.01	174.84	99.75	98.07
1987	46.32	48.05	45.60	44.68	44.72	43.64	41.80	40.73	40.18	40.79	41.49	41.61	44.63	43.24	42.38	47.32	50.46	50.59	56.40	72.74	88.27	101.17	108.55	113.39	116.27	143.46	107.33	100.29	89.58	115.50
1988	45.59	44.01	43.59	43.69	43.71	43.37	43.87	44.72	45.09	45.15	47.19	49.05	48.07	48.74	50.74	46.65	53.72	62.27	66.24	98.66	110.25	109.93	115.18	107.11	123.98	129.51	115.28	96.53	112.49	113.69
1989	52.73	45.87	43.04	44.34	44.81	45.19	46.77	47.32	47.57	48.79	50.74	48.90	47.85	47.03	47.72	54.10	61.45	77.74	102.24	132.21	108.67	110.54	115.08	119.49	125.96	109.94	100.17	105.00	114.20	120.67
1990	45.42	43.96	43.04	44.47	46.81	48.25	50.11	50.96	51.28	52.09	50.20	49.21	52.43	52.74	53.52	57.88	71.63	96.02	116.78	99.03	109.10	117.26	115.62	117.88	95.70	98.86	108.31	109.62	111.81	119.83
1991	44.05	41.63	42.71	45.40	47.91	49.58	52.42	51.81	51.92	47.44	48.77	43.60	45.84	49.77	59.59	78.30	95.44	117.65	103.84	94.18	101.54	108.50	105.03	94.44	94.30	104.70	111.35	113.60	119.37	117.90
1992	46.54	40.66	42.01	43.40	45.82	48.36	48.47	49.27	44.79	40.88	39.36	33.71	44.46	51.27	64.52	84.80	102.04	86.74	85.71	90.73	91.91	105.99	94.34	81.91	99.14	107.01	110.28	118.27	116.01	119.24
1993	37.10	36.36	38.57	39.53	42.81	42.66	41.44	39.06	35.16	32.54	34.98	40.18	44.05	58.32	72.44	89.96	85.49	79.07	82.22	85.34	87.56	83.14	74.95	96.73	105.85	106.38	114.38	115.16	116.34	126.50
1994	35.24	36.93	37.99	39.71	40.93	40.64	37.84	33.72	32.50	32.94	36.13	47.97	56.84	70.16	88.61	75.52	78.67	84.39	88.75	95.11	85.46	76.54	92.85	99.61	106.76	110.66	112.92	114.72	114.06	116.97
1995	32.72	37.20	38.55	40.27	41.69	40.97	36.54	36.18	37.45	37.96	43.39	50.70	78.06	84.47	80.39	78.34	80.06	87.27	88.93	85.51	77.25	91.19	99.45	102.73	106.00	107.66	114.13	115.00	117.11	128.24
1996	35.43	36.22	37.66	39.06	37.29	35.06	33.45	34.93	35.67	42.03	53.26	65.79	80.25	84.57	78.42	83.54	85.07	80.46	76.92	74.42	86.20	95.21	100.53	101.13	105.43	107.66	113.43	112.56	118.81	119.85
1997	23.84	35.87	36.54	36.48	34.71	34.15	34.60	37.49	40.67	51.08	66.31	81.23	81.33	79.99	80.87	88.20	86.48	76.88	72.51	83.56	90.71	95.79	100.20	103.49	107.34	106.33	114.45	117.53	121.37	126.79
1998	27.97	35.85	33.22	31.59	31.35	31.47	33.54	38.04	46.89	65.20	78.07	79.43	71.99	75.99	88.76	81.60	71.47	70.79	78.91	87.06	91.45	93.08	96.32	99.86	102.02	104.31	109.78	115.54	117.40	118.50
1999	29.99	32.47	30.34	29.95	30.43	33.09	37.12	44.23	60.98	73.93	74.87	69.08	76.61	83.46	77.44	70.61	68.71	76.25	83.56	88.06	90.57	93.54	96.35	100.58	103.97	106.14	109.98	114.80	116.63	122.58
2000	26.82	30.47	30.24	33.56	35.89	39.77	48.68	61.63	77.85	80.28	76.73	81.36	89.16	83.22	73.87	71.23	76.06	83.91	88.30	91.64	93.80	97.14	99.05	105.36	108.37	111.69	115.38	115.79	125.31	124.75
2001	28.48	30.15	33.53	36.71	39.23	46.22	58.92	70.89	74.32	70.97	77.35	82.88	78.40	69.20	68.55	72.82	80.01	85.17	86.87	90.64	92.48	96.39	99.36	102.00	106.74	109.81	112.57	117.10	118.13	123.50
2002	28.72	32.38	36.26	38.88	44.19	54.48	65.26	69.40	66.76	69.13	79.57	72.44	67.10	66.25	70.66	77.17	81.24	82.56	85.20	87.72	89.92	94.12	97.34	103.61	106.53	109.11	110.90	114.79	120.02	121.12
2003	34.11	37.39	37.05	42.36	51.54	61.04	64.39	62.93	65.35	73.02	68.58	63.53	62.85	67.86	73.23	77.14	78.60	80.71	82.52	85.37	89.49	93.54	95.81	101.61	105.13	110.23	110.72	115.19	115.53	121.84
2004	33.14	34.75	39.85	49.00	58.50	62.28	60.27	65.07	71.05	66.98	62.00	62.25	66.63	72.78	75.71	76.61	78.46	80.68	82.94	85.53	89.63	93.66	96.31	100.96	103.15	109.30	109.01	113.22	118.55	120.67
2005	34.68	39.55	47.94	58.49	62.62	61.10	65.13	71.98	68.91	61.82	61.86	66.84	72.38	76.04	76.74	77.43	78.60	79.50	82.60	85.03	87.77	91.22	95.24	97.91	102.68	105.69	108.07	110.78	113.80	117.81
2006	41.42	44.41	56.02	61.90	61.40	65.99	72.91	71.57	64.40	63.26	68.30	75.46	78.36	79.27	80.80	81.52	82.54	82.92	86.80	88.62	91.79	92.96	96.31	101.67	103.61	110.10	112.21	115.22	116.09	116.13
2007	32.88	52.78	59.94	59.86	64.76	73.83	72.02	65.03	62.03	66.29	73.14	77.47	79.82	81.11	82.17	82.64	83.68	86.29	88.35	90.15	92.78	96.87	99.90	100.65	104.71	110.40	113.35	118.24	118.03	124.67
2008	42.45	53.13	52.39	57.81	64.58	63.57	58.75	56.68	60.52	65.69	70.51	73.45	75.46	77.36	79.06	80.28	81.83	84.50	86.72	89.98	94.06	96.80	100.60	103.28	108.63	112.06	112.00	116.19	121.15	124.60
2009	40.11	42.10	47.38	51.51	49.74	47.29	47.47	49.72	53.99	56.63	59.56	62.94	65.38	67.52	69.62	71.81	74.78	77.31	80.80	84.15	87.23	90.17	94.71	99.32	101.81	104.39	109.24	109.60	110.68	119.36
2010	28.79	37.18	40.36	39.65	38.77	40.74	41.92	45.98	47.40	48.91	52.35	55.83	58.12	61.61	64.05	66.89	69.15	71.75	75.68	79.03	83.10	86.08	91.34	93.45	95.69	100.32	104.77	107.36	109.13	110.80
2011	26.66	32.21	32.11	32.68	34.51	35.43	39.57	41.89	42.21	44.59	48.35	52.26	56.18	59.04	61.72	64.99	68.19	71.43	75.52	78.84	83.09	88.03	92.39	91.44	96.19	99.33	102.99	108.36	113.31	111.85
2012	32.22	26.92	27.39	29.31	30.08	34.52	36.73	36.90	37.99	40.39	44.17	48.30	52.25	55.93	58.98	62.69	65.57	69.07	72.49	77.09	82.10	84.36	88.26	90.29	92.65	96.19	100.56	101.85	108.16	107.37
2013	21.09	24.85	26.29	27.99	32.65	34.33	35.09	35.26	36.66	38.91	42.25	46.75	50.56	53.39	57.36	60.91	64.11	69.08	72.36	75.59	79.75	83.87	86.39	88.27	94.66	96.64	98.99	102.80	106.35	111.28
2014	26.87	25.45	28.71	32.94	35.23	36.03	37.02	37.47	38.62	40.61	44.80	48.65	51.71	56.03	59.86	63.10	66.31	70.26	76.25	76.55	81.12	83.04	87.75	92.71	92.38	95.21	98.96	99.67	105.55	106.19
2015	26.34	28.59	32.79	35.55	37.08	38.15	39.03	40.14	40.91	44.33	47.80	51.69	56.13	61.25	64.69	67.67	70.25	75.02	77.53	82.10	84.06	88.36	90.90	95.20	96.63	103.04	103.65	105.96	104.81	109.73
2016	28.32	31.11	33.84	36.08	37.85	39.24	40.36	42.19	43.18	46.33	50.18	55.47	61.66	64.19	67.91	70.97	76.06	77.69	80.58	83.18	85.45	89.46	93.26	95.60	99.34	101.47	102.32	101.51	103.99	110.76
2017	28.57	31.05	33.05	34.75	36.65	38.01	39.06	40.74	42.88	45.99	50.81	57.42	61.16	65.24	69.21	73.69	75.23	78.51	81.19	83.87	86.48	89.99	93.07	94.47	99.07	102.14	104.87	105.46	106.75	113.41
2018	30.20	30.26	31.87	34.03	35.45	36.98	38.76	40.56	41.98	45.17	51.28	57.38	61.71	65.70	71.28	73.83	76.53	78.11	80.51	83.27	86.95	90.39	92.97	95.85	97.35	99.77	102.73	103.39	107.65	107.60
2019	27.79	29.99	31.62	33.72	35.16	37.03	39.26	40.56	43.49	47.44	52.69	58.17	62.65	68.39	71.11	75.07	76.25	80.01	81.39	83.36	87.14	90.17	92.51	93.40	98.09	100.31	99.77	105.12	106.48	108.54
2020	27.06	29.22	31.21	33.31	35.44	37.96	39.40	41.35	44.75	48.53	54.39	60.29	65.97	70.33	75.46	76.82	78.13	80.30	84.13	85.97	87.71	92.30	92.88	96.03	97.83	100.45	100.35	101.87	104.47	107.93
2021	27.64	29.22	30.90	33.91	36.20	37.74	40.14	42.85	45.85	50.45	55.44	62.74	67.09	72.25	76.07	77.60	79.13	84.54	85.67	88.19	91.79									

Loss Rates	Fixed Rate 30 Year Streamline Refinance Mortgages																													by Credit Subsidy Endorsement Cohort	
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1993	32.16	36.96	40.46	42.56	47.21	47.20	43.34	37.76	32.78	30.59	35.04	39.28	38.32	62.89	63.84	75.34	96.53	54.62	83.15	89.43	68.27	85.24	77.62	94.25	100.34	104.93	103.69	111.47	116.50	115.46	
1994	27.63	36.62	41.46	44.90	45.60	42.11	37.48	29.78	29.02	31.08	30.08	40.76	41.01	69.51	83.14	73.20	73.29	59.56	88.51	93.17	78.96	78.33	91.23	100.18	101.14	103.91	109.70	110.45	115.40	119.05	
1995	25.65	38.37	43.20	42.31	44.21	34.51	32.79	28.29	35.63	49.78	67.98	29.74	77.89	147.63	87.54	89.74	75.69	72.44	107.41	87.29	86.17	99.45	109.72	107.32	107.12	117.74	102.01	99.63	116.26	121.37	
1996	29.23	40.49	39.55	37.37	33.29	27.51	29.56	30.78	26.41	34.27	56.14	65.76	70.19	104.65	67.43	52.47	66.77	88.28	73.96	77.75	86.18	94.51	99.64	103.50	103.27	115.13	108.07	115.76	125.61	118.17	
1997	32.05	35.85	35.58	31.86	25.79	25.53	22.48	30.91	43.27	28.82	101.14	78.44	63.97	49.67	67.10	118.49	78.68	80.83	67.59	87.33	83.70	94.01	88.79	112.68	114.15	122.16	108.86	134.02	131.49	119.50	
1998	20.63	30.38	24.81	23.58	23.13	26.48	29.32	32.12	45.04	56.69	62.30	69.84	70.66	75.29	83.83	80.34	68.43	69.13	80.54	86.87	91.19	95.17	99.03	102.41	106.15	107.76	110.48	116.39	114.54	106.17	
1999	23.29	24.00	24.51	23.58	26.12	29.49	32.78	43.14	62.44	60.59	70.81	70.71	65.08	76.37	71.83	72.50	71.23	75.73	83.46	87.70	91.37	95.33	96.02	99.50	101.65	108.89	111.22	107.62	114.65	121.00	
2000	11.99	24.01	24.92	29.48	29.11	30.88	40.15	41.45	85.54	102.93	62.19	76.92	119.41	114.66	68.53	78.87	75.90	83.07	85.90	90.81	97.07	102.92	127.51	100.12	109.68	115.06	106.96	122.82	120.32	113.34	
2001	17.67	25.74	29.55	30.47	33.24	40.35	55.73	70.98	72.57	73.29	75.30	82.84	80.01	72.75	70.61	76.24	79.64	85.27	86.83	89.14	91.52	95.42	97.97	98.66	104.09	108.42	114.78	116.06	116.27	122.00	
2002	16.84	28.74	31.60	33.19	37.15	51.55	63.70	67.30	66.55	71.94	76.64	73.37	68.77	67.00	71.77	76.39	80.20	82.12	84.20	87.24	90.12	94.66	96.30	101.68	105.80	109.57	110.92	112.87	118.26	123.85	
2003	21.70	30.55	31.86	36.53	46.75	60.21	62.00	59.74	63.16	71.56	66.61	64.37	64.06	66.86	73.29	76.80	77.43	80.05	82.81	83.45	88.72	91.17	94.98	100.57	102.25	106.49	109.37	113.35	116.21	119.82	
2004	29.70	30.35	36.04	46.22	56.53	61.09	58.72	63.14	68.97	64.43	59.13	61.18	64.60	69.98	73.40	74.50	76.56	79.11	80.54	84.59	89.55	91.68	96.47	98.93	101.85	107.57	109.42	113.95	118.63	121.82	
2005	26.63	34.16	45.89	58.90	62.75	61.11	64.34	68.52	67.00	59.41	60.30	65.80	72.49	74.85	75.61	77.49	79.27	80.49	84.05	87.68	93.74	94.08	99.91	103.30	105.11	109.91	114.44	114.55	120.01	123.90	
2006	31.09	40.72	58.66	61.71	63.57	67.73	73.31	70.02	61.20	59.80	65.06	74.31	75.29	78.78	79.61	78.71	80.87	89.40	86.08	90.42	95.22	99.06	99.20	110.21	111.57	110.27	110.56	122.06	120.96	129.64	
2007	33.96	51.58	62.98	63.30	69.00	76.07	74.77	68.49	65.49	70.38	76.61	82.31	82.64	83.71	83.35	86.91	87.31	87.30	94.02	93.87	94.98	99.27	102.71	105.28	109.43	118.34	123.53	120.74	127.50	127.07	
2008	38.24	56.58	58.23	65.12	73.58	73.67	67.16	64.66	69.36	74.78	79.28	81.68	82.93	84.28	85.14	85.36	87.82	89.84	92.35	93.46	98.97	101.62	105.76	108.79	109.76	114.82	120.52	122.43	123.39	127.95	
2009	43.13	47.83	53.95	59.27	58.26	58.52	59.45	63.03	67.37	69.24	71.86	73.76	75.21	76.62	80.12	79.86	82.66	85.07	87.88	90.36	93.13	97.14	99.03	102.74	104.13	108.63	112.35	116.77	119.57	122.16	
2010	38.00	50.35	52.58	50.64	51.35	54.03	57.33	61.67	63.55	63.89	66.43	69.06	70.71	73.26	76.29	78.54	80.16	83.37	85.18	88.07	89.86	94.90	98.88	101.75	103.00	107.87	109.84	115.31	117.59	123.60	
2011	37.15	44.56	43.52	44.79	46.76	49.14	53.06	55.42	55.47	56.20	59.27	63.07	66.53	69.45	72.68	73.11	76.80	79.63	81.69	85.54	90.32	90.93	96.22	99.02	100.08	106.11	108.77	112.24	116.48	118.78	
2012	38.13	37.79	38.65	40.81	43.23	46.55	48.61	48.86	49.50	51.58	54.89	58.56	62.89	65.56	68.01	71.48	74.03	75.91	81.86	83.38	87.71	90.33	91.94	97.65	100.05	102.66	106.16	109.71	113.10	116.65	
2013	35.13	34.40	35.76	37.96	42.63	44.36	44.99	45.67	46.00	49.05	53.38	58.43	61.16	64.36	68.09	70.45	74.01	76.14	80.76	84.02	86.38	88.99	91.61	96.09	99.06	102.72	106.15	109.04	113.57	115.49	
2014	41.62	34.12	35.31	41.99	43.82	45.31	47.51	47.63	48.98	52.14	56.59	61.46	63.20	69.20	73.16	75.76	79.25	82.61	88.09	90.19	93.10	95.36	98.02	101.93	104.12	107.31	111.39	112.64	119.47	119.34	
2015	32.06	33.03	36.67	40.36	41.45	44.38	46.41	48.59	49.95	53.29	58.08	62.86	66.33	70.00	77.33	77.16	81.84	82.23	87.20	91.64	94.57	93.95	95.42	100.65	100.10	108.45	108.67	107.93	111.29	117.89	
2016	30.11	32.97	36.13	37.65	39.62	41.73	47.19	50.43	53.08	56.99	61.84	69.86	72.52	81.79	89.59	90.63	84.08	91.09	94.77	100.46	104.55	98.60	108.12	110.09	112.04	118.51	115.55	109.29	110.98	115.52	
2017	33.24	32.57	33.94	36.04	37.97	42.01	44.17	47.34	50.95	53.76	62.30	68.90	71.76	77.65	82.85	83.92	89.53	86.56	88.11	94.88	92.34	96.91	98.53	104.83	101.81	111.73	109.62	107.52	117.42	119.12	
2018	32.38	31.10	33.63	35.93	38.59	42.64	46.23	49.78	53.57	58.12	66.76	71.43	77.88	86.30	92.15	96.67	97.62	100.46	98.27	103.56	110.34	112.59	107.12	107.52	108.56	109.08	111.69	111.57	112.58	111.53	
2019	29.74	30.47	32.23	35.19	39.14	41.90	45.95	50.63	54.96	62.28	68.29	73.20	79.36	89.48	91.27	97.85	95.64	98.45	102.25	107.73	110.31	111.12	108.83	106.57	102.05	110.45	110.91	108.99	110.60	110.46	
2020	29.07	30.79	33.16	38.56	41.00	45.76	49.74	56.54	58.99	64.41	72.60	80.03	87.09	93.86	96.94	102.45	104.91	108.24	110.95	114.81	117.92	113.97	111.77	110.70	109.21	112.62	113.05	112.57	106.83	117.19	
2021	28.65	29.76	33.35	36.13	39.51	42.50	48.04	52.39	54.63	59.30	65.16	71.90	75.08	80.75	85.45	89.54	92.55	94.08	98.10	105.60	105.47	99.20	101.77	100.79	101.96	109.34	110.88	107.02	114.70	114.85	

Loss Rates		Fixed Rate 15 Year Mortgages by Credit Subsidy Endorsement Cohort														
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1999	0.00	31.03	39.06	37.95	41.47	50.21	61.66	117.72	89.42	81.40	109.45	158.59	123.20	77.03	164.32	
2000	0.00	28.57	41.08	37.48	53.15	57.41	72.70	68.57	97.45	158.23	115.41	145.74	0.00	336.19	59.71	
2001	0.00	36.71	42.67	47.06	49.88	61.37	83.09	68.11	62.48	53.94	122.82	178.43	165.87	92.44	63.53	
2002	3.76	43.09	40.77	46.66	42.35	61.88	83.99	87.74	87.78	98.22	117.37	81.45	75.14	70.75	67.36	
2003	73.56	44.71	40.46	46.84	60.75	69.49	74.01	79.38	81.45	131.51	102.37	61.88	54.98	68.89	83.34	
2004	28.27	36.46	51.89	55.92	60.91	72.15	66.18	72.53	81.45	73.19	62.50	63.39	69.39	81.28	87.58	
2005	18.25	43.78	46.46	56.77	62.49	57.75	71.72	94.26	91.22	60.67	55.77	64.75	65.88	69.37	74.04	
2006	39.55	51.61	59.90	68.25	64.44	72.24	87.42	72.01	64.37	53.02	58.36	67.63	74.21	75.80	75.38	
2007	56.44	52.39	66.15	62.02	70.60	90.24	82.17	62.39	56.12	55.36	65.99	67.51	74.62	79.14	75.81	
2008	48.04	52.48	54.21	63.28	75.36	74.06	59.01	53.70	55.91	61.73	67.92	70.15	75.03	75.90	77.57	
2009	51.27	43.88	54.00	60.57	57.77	54.20	50.23	53.05	57.94	62.85	62.10	67.75	75.86	78.39	75.80	
2010	0.00	46.60	47.39	50.81	46.82	47.61	49.77	50.70	53.30	54.60	59.23	63.05	63.55	68.44	69.53	
2011	38.31	49.65	41.87	42.92	44.17	45.34	47.94	49.78	49.39	55.54	61.88	58.73	67.11	68.12	64.92	
2012	64.69	32.50	37.91	43.46	44.14	46.70	49.40	47.97	44.35	50.56	55.91	57.82	61.41	65.31	72.74	
2013	22.43	30.84	41.37	41.52	44.14	43.42	45.63	44.98	42.88	46.11	53.70	58.43	62.35	69.08	69.03	
2014	0.00	36.07	41.87	54.46	44.46	49.09	40.33	45.35	48.71	51.54	62.14	68.23	67.05	67.80	80.21	
2015	71.59	43.41	54.74	57.35	52.00	43.92	54.34	57.11	48.68	56.14	47.82	62.15	67.62	69.29	71.09	
2016	63.49	54.66	49.48	52.98	54.88	48.59	47.82	45.46	44.06	57.19	56.61	62.27	59.68	66.18	74.37	
2017	0.00	51.12	50.11	51.17	53.48	53.53	53.07	49.70	52.60	53.74	49.03	62.12	67.34	80.98	100.36	
2018	0.00	57.89	50.59	49.27	56.75	50.14	54.86	46.97	41.72	47.76	60.44	58.11	73.84	76.09	62.19	
2019	24.87	54.74	49.56	46.80	47.75	43.89	51.20	47.58	52.54	47.56	62.71	61.22	73.11	64.30	72.87	
2020	0.00	39.47	55.66	47.94	50.00	44.59	53.40	46.18	48.13	49.97	48.37	54.34	65.06	77.52	101.36	
2021	36.27	53.60	51.06	53.78	49.04	51.53	52.11	59.10	55.20	60.21	66.93	65.52	70.33	67.13	80.98	

Loss Rates	Fixed Rate 15 Year Streamline Refinance Mortgages														by Credit Subsidy Endorsement Cohort
	Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	
1993	0	32.488	42.37	34.677	38.398	49.192	52.57	53.357	39.372	65.353	47.05	36.845	41.433	56.064	611.02
1994	53.69	36.82	38.60	41.46	48.01	51.25	52.70	50.57	60.43	40.47	72.46	112.12	214.76	168.99	187.68
1995	133.47	39.85	40.43	42.16	38.94	48.39	42.18	70.87	39.13	81.04	0.00	159.19	0.00	0.00	770.18
1996	0.00	41.10	55.34	37.81	55.18	35.23	32.31	31.59	71.92	120.27	124.46	191.85	0.00	775.83	0.00
1997	0.00	34.03	49.63	49.84	62.06	52.94	63.11	90.91	24.23	81.46	86.76	0.00	96.95	0.00	0.00
1998	0.00	23.13	30.97	29.41	45.62	42.60	38.81	49.07	164.79	139.28	96.76	127.82	108.72	339.24	291.83
1999	0.00	34.50	30.75	24.01	37.73	37.21	34.93	49.18	81.04	80.30	83.44	112.96	126.80	233.10	104.76
2000	0.00	16.17	41.32	21.59	27.01	60.86	86.36	91.37	123.65	106.73	142.54	0.00	261.86	332.41	59.38
2001	0.00	27.58	41.48	40.90	44.73	50.39	60.03	150.12	127.18	104.75	101.97	107.42	85.05	102.41	85.96
2002	0.00	36.70	35.23	40.40	43.71	59.32	69.61	72.65	100.97	68.03	120.93	119.82	73.73	68.54	71.84
2003	0.00	34.76	31.87	42.48	65.36	67.56	91.93	72.72	77.50	83.65	89.80	67.71	60.62	68.05	76.18
2004	32.71	39.01	37.17	48.87	61.16	66.57	72.73	64.50	82.16	73.82	60.70	60.12	64.94	73.87	77.65
2005	36.67	35.37	52.24	64.34	59.63	59.67	74.83	88.36	69.61	66.78	49.16	64.20	72.74	77.04	80.29
2006	0.00	42.04	64.39	55.95	68.56	65.74	97.70	65.00	51.90	44.88	59.47	63.58	75.88	67.63	79.44
2007	0.00	42.88	60.86	41.10	93.13	61.88	71.37	72.12	48.80	60.95	72.70	63.40	55.36	76.44	77.14
2008	0.00	41.35	72.74	52.28	72.44	78.15	59.62	53.02	51.68	57.45	65.40	64.39	75.03	74.72	80.17
2009	0.00	43.43	53.24	62.01	62.66	59.74	55.51	56.46	53.33	59.34	65.07	64.95	65.16	72.81	77.68
2010	57.34	55.11	56.01	57.71	55.38	55.60	54.26	57.01	53.23	61.62	64.27	61.67	62.57	73.33	82.69
2011	0.00	49.94	41.17	45.02	48.70	51.51	51.88	48.44	56.21	56.37	58.21	58.59	70.15	73.64	67.99
2012	0.00	41.27	39.92	42.35	41.41	37.61	44.01	44.43	48.73	52.57	63.91	56.34	69.42	65.52	71.04
2013	0.00	30.67	34.41	41.12	39.94	43.77	40.44	38.16	46.23	52.01	55.66	63.56	65.99	69.34	80.70
2014	0.00	22.91	39.98	47.86	40.67	37.77	50.76	50.02	50.13	64.03	62.23	72.87	65.80	77.61	82.40
2015	0.00	0.00	47.21	0.00	49.17	49.50	48.39	53.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	0.00	0.00	41.60	0.00	59.50	46.63	0.00	61.21	0.00	0.00	0.00	0.00	0.00	75.93	0.00
2017	0.00	42.27	40.51	72.71	83.90	40.57	39.74	46.39	0.00	0.00	0.00	113.66	0.00	0.00	0.00
2018	0.00	0.00	36.33	43.42	56.98	52.07	46.77	54.66	68.64	54.77	0.00	0.00	54.90	0.00	0.00
2019	0.00	0.00	41.21	55.09	52.90	52.71	48.44	54.94	65.97	87.63	70.70	78.67	64.13	119.77	0.00
2020	0.00	0.00	37.57	43.22	58.91	57.34	48.86	89.51	64.87	42.64	73.63	67.01	73.71	0.00	0.00
2021	0.00	30.28	37.79	45.96	45.71	42.62	57.14	51.17	55.96	60.33	71.62	69.79	0.00	0.00	0.00

Loss Rates	Adjustable Rate Mortgages by Credit Subsidy Endorsement Cohort																													
Book/Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	30.80	41.62	41.85	43.20	42.84	46.68	46.19	43.59	41.20	36.41	25.02	30.68	33.04	21.29	31.93	71.28	82.18	86.40	101.84	82.25	91.85	94.21	84.87	83.01	97.76	100.58	105.40	107.56	111.39	116.72
1993	38.57	38.02	40.10	39.02	43.12	42.79	40.79	37.11	30.29	26.78	25.89	27.52	45.36	55.90	69.41	88.70	69.12	83.44	121.00	72.73	94.77	93.58	77.71	91.88	98.30	106.39	106.99	108.98	113.05	116.12
1994	26.75	37.86	39.14	40.22	39.79	36.10	32.30	27.96	26.08	31.10	29.97	42.36	38.88	62.66	115.62	70.23	77.38	86.88	92.08	93.63	72.95	74.07	84.82	96.38	100.32	104.43	107.49	110.06	112.00	117.13
1995	40.82	38.41	41.25	40.97	38.34	35.34	31.63	28.55	35.37	34.13	40.14	47.37	83.99	76.38	86.82	79.08	79.77	85.73	97.42	81.20	78.95	90.34	96.33	97.81	101.78	105.08	108.96	115.25	114.97	121.64
1996	38.66	41.05	38.58	34.87	33.96	31.03	27.89	32.02	35.14	35.70	46.30	66.04	78.91	78.73	63.45	89.82	89.24	87.50	81.53	74.04	80.77	91.96	96.58	97.88	100.83	104.69	109.27	110.91	117.31	118.41
1997	26.53	38.43	34.32	32.10	30.36	29.49	30.64	35.44	39.37	45.17	62.48	82.05	81.48	81.66	81.74	82.95	87.68	76.52	75.42	81.91	89.80	92.96	97.55	98.82	101.33	106.69	111.61	115.11	120.40	122.23
1998	29.57	36.09	30.32	29.98	29.72	30.73	34.49	32.22	48.81	53.80	67.35	75.45	70.79	83.61	81.93	83.75	71.24	70.63	75.25	85.63	91.66	92.34	98.18	99.00	100.35	105.87	110.97	116.16	117.03	122.97
1999	0.00	30.61	27.90	27.84	27.20	29.06	33.83	35.41	51.11	61.56	65.33	66.94	79.44	73.85	74.25	65.43	61.25	72.25	80.07	84.07	87.96	88.65	93.58	95.23	100.34	104.72	107.84	113.47	113.84	119.64
2000	20.74	29.83	28.25	32.38	32.85	35.89	39.05	50.99	64.20	62.99	63.07	76.14	80.80	68.77	66.35	63.27	69.43	77.66	81.53	86.12	86.59	92.62	94.56	96.90	101.72	107.39	110.18	113.28	118.10	123.65
2001	0.00	27.89	32.53	32.97	37.58	41.10	53.30	64.82	66.76	68.69	70.54	70.82	71.59	61.90	65.57	66.57	74.17	78.30	82.58	83.79	88.87	92.25	95.13	97.08	107.64	110.07	111.29	109.15	119.60	123.62
2002	17.95	28.19	32.80	31.23	38.76	47.10	61.18	63.26	67.09	71.13	75.94	74.76	61.26	61.18	66.43	70.57	73.80	78.84	80.99	81.06	88.00	90.19	95.78	97.75	103.01	107.80	108.70	114.56	115.03	123.59
2003	20.11	33.54	31.93	37.30	48.18	55.58	65.93	64.79	69.52	79.23	75.04	67.64	60.37	63.98	71.23	74.35	78.44	79.08	79.65	85.05	87.03	91.86	98.60	102.57	105.29	107.21	109.59	113.18	117.89	121.36
2004	28.98	31.65	36.20	46.69	56.48	63.47	62.56	65.72	76.09	71.08	61.85	60.42	64.01	67.96	71.47	74.30	74.51	77.66	79.47	85.39	87.13	92.73	96.86	98.31	100.81	104.60	111.04	114.21	117.77	120.98
2005	32.86	36.24	47.94	58.00	63.03	62.87	68.93	75.47	67.88	61.30	59.97	62.07	67.85	70.13	70.32	72.60	72.91	74.80	76.95	80.91	86.24	88.82	91.89	95.91	98.29	102.62	107.29	110.57	114.24	116.36
2006	27.18	46.36	58.45	65.60	63.26	66.56	73.06	71.05	61.47	59.82	62.77	69.69	70.86	72.24	73.27	71.30	74.59	78.38	78.21	83.76	84.52	85.95	91.78	96.50	99.76	100.07	104.88	112.64	116.94	112.71
2007	0.00	50.73	57.86	60.30	65.07	71.67	67.03	61.06	58.36	62.61	66.92	71.13	70.13	72.53	72.77	74.49	74.79	76.70	83.66	83.01	83.59	85.44	89.63	91.54	101.90	104.18	110.16	115.49	121.56	110.49
2008	12.12	48.83	46.26	56.46	58.46	58.86	55.23	54.65	56.13	57.41	62.61	64.01	66.07	70.43	72.36	70.50	76.05	75.62	80.46	83.43	87.17	90.74	92.18	98.01	99.89	101.00	102.44	112.34	115.29	118.91
2009	32.91	37.94	48.73	49.89	46.27	50.69	47.91	47.71	53.07	54.86	56.06	57.40	64.55	59.84	65.84	69.75	74.57	77.12	77.47	84.71	87.25	85.76	91.31	94.45	98.72	101.02	107.52	106.95	115.57	122.77
2010	26.29	32.92	37.55	37.11	41.73	41.91	42.18	45.21	47.25	48.62	50.83	54.78	59.54	63.46	65.45	68.26	69.18	73.89	80.01	81.74	83.48	88.75	90.37	89.80	98.29	100.95	105.81	105.87	112.13	113.57
2011	0.00	28.54	30.13	35.78	36.20	37.68	41.96	43.49	44.18	46.16	51.61	54.19	59.29	64.31	67.76	70.49	75.78	76.25	79.28	82.34	83.26	86.48	93.37	91.52	98.07	100.58	104.89	104.75	113.46	113.59
2012	50.03	25.29	35.29	31.89	33.07	39.82	40.05	41.61	42.23	46.05	51.15	57.45	59.51	65.42	70.35	73.61	74.89	75.94	78.33	81.67	87.43	88.33	90.64	95.39	95.88	104.03	104.35	111.29	113.11	112.72
2013	0.00	28.68	31.78	30.92	34.16	35.34	37.11	38.00	44.03	43.25	47.41	56.98	55.22	67.02	66.96	69.45	70.24	76.41	81.74	84.69	85.06	82.40	93.10	93.50	92.07	95.22	96.71	98.28	108.98	104.40
2014	48.16	26.97	27.42	32.61	37.61	37.11	42.79	43.46	44.05	39.17	51.82	57.00	58.84	68.25	69.93	72.88	74.09	80.15	81.73	89.80	92.25	81.83	89.77	96.63	93.73	100.47	112.29	103.15	102.27	113.11
2015	0.00	31.24	35.31	36.10	40.50	44.62	47.21	48.87	48.28	52.26	58.04	63.35	61.31	70.17	75.22	75.78	74.44	80.78	80.94	89.64	86.21	89.41	88.89	98.02	97.77	107.31	107.61	100.92	117.61	108.66
2016	0.00	32.43	36.02	38.75	41.93	48.73	50.40	49.23	52.31	59.94	65.49	72.49	68.89	72.82	72.16	74.48	82.47	75.15	83.82	89.25	84.68	81.35	94.04	93.14	87.56	97.41	89.70	105.67	109.65	123.12
2017	27.79	35.47	36.86	37.64	44.72	44.43	43.08	49.70	51.40	57.59	59.87	65.41	69.59	78.99	78.71	74.58	78.47	77.23	76.67	86.51	87.74	82.28	85.34	97.10	94.58	105.43	98.38	110.15	108.88	109.36
2018	0.00	30.04	36.43	36.19	41.91	45.76	45.07	52.85	50.11	54.24	61.17	67.33	69.34	74.17	79.93	77.55	84.62	79.40	74.25	89.53	89.35	92.80	92.73	86.87	93.40	102.10	98.96	111.78	110.41	104.21
2019	0.00	31.41	32.27	38.02	40.67	45.04	50.35	53.27	53.55	55.12	61.54	68.73	67.96	69.08	71.88	75.69	86.69	87.85	88.17	90.63	88.24	86.35	90.39	90.38	108.73	101.79	106.12	107.14	108.96	121.01
2020	0.00	33.96	34.12	36.53	40.41	42.76	46.41	50.30	50.93	58.20	65.06	61.70	71.44	69.20	68.41	79.54	79.01	85.53	85.28	87.69	86.51	88.88	89.54	91.06	102.08	110.35	106.89	114.54	123.07	112.06
2021	23.83	27.08	33.35	39.85	42.26	40.79	48.03	50.65	50.67	61.22	67.36	69.98	65.54	76.37	82.18	80.34	83.27	83.58	83.44	82.56	89.95	86.76	93.22	93.70	93.56	116.40	118.04	108.46	109.50	96.21

Loss Rates	Adjustable Rate Streamline Refinance Mortgages															by Credit Subsidy Endorsement Cohort														
Book/Po	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1995	0.00	41.78	37.32	45.63	34.17	40.82	17.82	2.75	14.48	35.99	41.89	14.53	88.56	140.07	47.46	155.09	129.43	0.00	0.00	49.27	102.80	89.75	104.22	100.56	87.55	0.00	109.80	110.69	132.01	117.17
1996	0.31	35.55	37.14	36.00	27.44	23.05	20.17	34.11	53.42	22.25	47.67	46.05	43.76	185.43	57.47	40.66	93.46	5.64	62.87	85.01	80.21	84.59	78.51	96.49	98.70	110.83	110.94	107.71	113.59	112.90
1997	28.26	38.57	31.10	29.55	26.07	18.23	26.50	28.15	48.85	29.04	34.89	60.51	70.88	86.86	141.90	70.07	60.08	85.30	72.06	79.35	104.74	106.83	102.77	117.79	117.70	104.54	104.44	131.58	120.46	127.84
1998	28.73	26.03	27.47	23.37	16.84	25.59	32.30	28.20	20.39	0.00	31.71	-35.01	55.66	52.04	52.54	79.68	74.37	77.49	82.16	86.61	100.22	98.00	101.12	99.08	111.88	98.36	111.30	118.86	113.68	121.89
1999	0.00	26.87	25.04	21.07	24.44	33.03	29.93	37.08	76.79	87.67	49.69	31.20	94.66	77.13	83.14	69.12	65.84	76.11	82.52	85.02	83.46	89.37	94.50	91.32	100.81	107.48	99.86	114.56	120.55	110.57
2000	0.00	31.84	25.06	26.16	33.75	26.58	31.08	59.15	64.01	40.90	73.65	75.11	79.96	100.78	70.52	70.85	74.83	86.73	86.29	87.69	92.72	97.82	89.53	105.63	106.00	106.64	106.52	118.10	112.78	121.92
2001	25.08	28.48	34.08	33.54	31.09	42.33	58.24	70.96	61.54	64.40	57.45	94.44	79.16	58.67	67.72	70.22	80.76	79.33	80.34	90.87	84.45	96.03	94.51	105.93	102.77	102.19	109.67	118.55	111.36	115.09
2002	11.76	25.59	30.01	30.91	37.12	49.12	66.36	66.10	67.66	69.87	72.16	75.28	67.91	62.38	66.04	72.52	75.88	80.96	81.03	84.31	87.55	86.73	94.23	102.46	103.52	101.75	110.51	112.61	119.14	123.63
2003	23.52	30.04	30.93	32.45	45.72	56.77	62.87	61.81	71.08	70.57	70.41	64.07	59.36	62.40	69.05	74.47	76.78	79.74	79.73	83.44	91.08	90.79	98.40	98.41	98.94	108.51	112.04	114.63	121.18	119.98
2004	27.25	29.55	35.63	46.72	55.05	61.37	58.66	66.19	75.12	67.58	63.60	61.88	63.63	69.33	74.38	73.44	77.78	78.72	80.08	85.60	88.81	93.03	94.64	101.13	105.65	108.29	110.45	117.64	118.34	121.63
2005	28.18	32.30	48.45	59.65	62.04	62.68	58.87	75.56	67.76	61.27	57.49	62.69	66.66	71.22	72.29	74.22	76.36	78.62	80.42	83.34	88.81	91.73	95.43	99.03	100.16	107.13	113.89	113.95	118.81	119.23
2006	0.00	45.32	52.47	59.71	59.21	65.54	71.75	62.13	62.62	58.49	67.74	56.73	71.08	65.62	82.34	72.54	73.89	83.60	78.03	102.24	81.73	87.29	97.18	106.63	103.21	105.74	110.81	107.11	121.49	0.00
2007	0.00	56.29	80.86	67.90	69.14	74.68	83.07	73.96	63.44	64.94	74.16	62.42	93.47	80.68	86.71	91.30	81.06	91.14	88.17	95.41	85.65	104.59	0.00	116.91	0.00	112.73	0.00	0.00	0.00	0.00
2008	0.00	46.07	61.55	72.78	78.03	80.42	70.31	66.31	69.56	69.05	78.78	77.91	78.78	73.05	84.63	79.49	86.47	84.51	91.75	103.10	96.17	97.48	101.02	117.41	117.76	118.93	115.95	124.80	129.78	135.89
2009	43.03	50.54	55.53	60.47	59.39	61.80	59.28	60.48	64.90	67.45	69.28	70.02	74.07	78.42	76.33	80.88	82.29	78.92	90.13	89.73	91.73	91.69	102.43	99.78	107.11	101.81	110.69	111.87	112.42	124.85
2010	41.21	46.34	51.78	53.39	55.55	56.38	57.54	59.56	62.48	62.38	67.92	69.39	71.60	73.92	78.32	77.31	82.61	85.20	87.03	87.32	89.45	94.09	105.47	99.23	108.16	107.97	115.90	117.66	113.07	118.03
2011	44.82	41.62	40.57	44.89	47.29	49.02	54.24	54.03	54.76	56.69	61.45	64.19	65.24	71.37	74.57	81.22	83.35	85.14	87.09	88.25	89.64	92.47	96.86	103.58	101.47	110.44	110.09	111.67	116.52	123.83
2012	37.13	35.04	39.17	41.95	44.34	49.73	51.51	54.26	55.05	56.31	64.42	64.36	68.97	72.82	74.75	79.73	85.24	89.45	91.49	90.23	92.37	106.71	105.91	99.97	100.27	110.07	114.36	110.64	113.61	119.13
2013	28.04	32.33	35.47	38.61	43.80	46.84	48.65	52.00	50.71	50.57	67.30	67.80	64.62	79.18	70.43	79.05	79.22	83.76	82.52	97.72	106.30	94.61	103.14	106.95	102.90	108.80	115.81	121.49	137.17	0.00
2014	31.97	32.89	33.00	39.79	41.67	43.68	47.40	46.81	48.74	49.97	64.67	64.07	75.80	83.76	78.08	76.81	88.14	90.42	97.23	136.68	96.17	94.71	73.55	114.51	117.72	110.68	116.13	126.29	116.10	134.65
2015	0.00	33.71	32.23	43.55	38.63	38.15	43.54	41.70	44.61	41.54	62.99	61.76	60.84	80.78	98.15	91.25	89.23	0.00	0.00	0.00	129.51	94.96	0.00	94.93	97.45	134.84	0.00	0.00	0.00	0.00
2016	0.00	31.84	31.06	41.61	35.86	37.49	51.21	48.70	54.45	37.93	45.68	76.54	82.69	84.67	102.10	97.81	110.94	112.49	99.54	0.00	84.82	110.43	0.00	121.39	0.00	0.00	0.00	0.00	0.00	0.00
2017	33.81	34.38	29.99	45.11	38.14	38.29	54.84	44.26	48.65	37.89	59.83	62.53	74.73	98.45	101.72	86.94	69.24	0.00	71.74	0.00	0.00	79.99	91.34	96.68	0.00	0.00	146.82	0.00	0.00	0.00
2018	26.18	29.30	34.10	39.71	38.56	37.20	42.55	46.21	46.79	42.65	66.33	69.38	68.21	93.81	81.86	78.46	85.83	0.00	0.00	155.35	119.46	99.45	97.91	130.00	97.26	0.00	134.06	122.22	0.00	0.00
2019	23.81	32.71	28.63	39.61	39.38	42.05	55.49	43.75	46.22	44.26	59.82	74.71	70.84	88.13	93.88	97.17	81.74	0.00	91.79	0.00	100.08	101.90	107.47	0.00	111.15	185.01	0.00	115.89	96.47	115.04
2020	29.06	31.78	28.28	37.82	39.83	40.92	58.29	54.54	45.00	46.62	65.32	71.65	69.69	85.65	95.50	102.55	69.57	95.94	112.19	101.99	94.07	98.25	97.73	128.64	107.13	141.46	117.19	120.62	111.09	0.00
2021	31.99	32.06	30.99	38.09	41.51	41.00	55.40	61.11	53.88	43.65	58.77	68.79	72.84	79.63	89.90	94.08	75.43	94.08	82.87	0.00	105.84	92.72	101.22	95.19	100.32	0.00	0.00	109.10	0.00	0.00

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